50X1-HUM DEPTH GAUGES, TRIM INDICATORS AND INCLINOMETERS **DESCRIPTION AND MAINTENANCE** INSTRUCTIONS M641-A76-271 50X1-HUM

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I. DESCRIPTION	
A. PURPOSE AND BASIC SPECIFICATIONS	
The depth gauges are designed to determine depth of substance of the submarine; the trim angle indicators and the change are used to read angles of trim and list remarkely.  The submarine is equipped with:  Spring-type depth gauges with ranges of four outous, from 0 to 160 m, from 0 to 600 m;  bubble-type trim angle indicators with a scale of heratice 20-0-20°;  pendalum-type inclinometers with a scale of heratice = -55°.  For technical characteristics see Table 1.  The pipe line of the depth gauges is worked in red copper pipes:  with an external diameter of 9 mm and a thickness of which is no inside the pressure hull;  with an external diameter of 14 mm and a thickness of which is mm outside the pressure hull.	
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		20*/204	600/400	40/20	160/110	600/4003
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#### B. GENERAL DESCRIPTION AND DESCRIPTION: OF INDIVIDUAL UNITS

#### 1. General Description

The submarine carries eight depth gauges.
The depth gauges communicate with the sea through the pipe lines terminating in a bend which safeguards them against dirt.

The pipe lines may be disconnected from the depth gauges with the aid of outboard valves 2, 5, 18, 21 and 23.

All the outboard valves are seated above the waterline.

Blowing the pipe lines is effected through valves 1, 8, 32 and 26 with intermediate-pressure air.

Arranged before the depth gauges are two-valve manifolds, 0, 9, 11, 14, 17, 20 and 25 which are used to disconnect to cepth gauges when blowing the pipe lines overboard, as well as for relieving pressure from the depth gauges. To protect the depth gauges from vibration, they are secured mough shock-absorbers, and an expansion ring is provided on a ripe before each two-valve manifold. For arrangement of the tepth gauges, their specifications and the distance from the lepth gauges to the base line see Table 1.

for the depth gauges mounted in the control room the also gives the heights to the top of the conning tower and.

ine depth gauge resis the depth of submergence of the in-

To describe the depth of submergence of the lover edge

e succarine teel, add to the gauge readings the values

to column 5. When the depth of submergence of the con
tower smil top is to be determined, subtract the dist
" elsen in column 9 from the depth indicated on the gauge.

then shorting, for precise results, the depth gauge read
the should be corrected for parefaction created in the con
tar secure by subtracting a correction according to the eneroid

become ter resulings from the gauge readings.

the corrections are given in Mable 2.

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Table:

No.	Baroneter r	ending Correction.
1	740	0.30
2	730	0.40
3	720	0.50
44	710	0.65

The submarine carries on her board:

- five bubble-type trim indicators arranged as follows:
  the in the control room; one in the conting tower; one in the
  tors compartment and one in the aft compartment;
- three inclinometers arranged as follows: two in the country room and one in the coming tower.

#### 2. Description of Individual Units

#### Depth Gauge

The depth gauge is just a spring-type pressure gauge graluated in metres of water column.

### Trim Indicator

This represents an enclosed glass tube bent round a rations and filled with coloured liquid, with sir bubble left inside whose diameter is equal to one division of the scale (10).

The glass tube is placed in the mounting with the scale , winated into degrees, zero being located in the centre of the scale.

The angle of trim is determined on the scale by the posi-

When the instrument is in a horizontal position, the centre of the bubble is against the zero of the scale.

To facilitate observation of the pubble, the trim angle indicator is equipped with a light sud a switch. The trim angle indicator is nounted through shock-absorbers.

Sanitized Copy Approved for Release 2011/08/05: CIA-RDP82-00038R002100080001-1 50X1-HUM This consists of a plastic essing, a pointer with plumb tob (pendulum) being secured in its upper portion. The casing has a window located in parallel with its over arc-shaped portion which shows a scale graduated from . 920 to 50° to both sides. The division value is 1°. Then the submarine is inclined, the deflection of the mer will correspond to the amount of list either port ararboard. The instrument is installed on shock-absorbers. Two-Valve Hanifold This consists of two shut-off valves. Its arrangement function diagram are shown in Fig. 2.

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II.	INSTRUCTIONS FOR MAINTENANCS	·
	OF DEPTH GAUGE PIPE LINES	
å. (	GENERAL SUPERVISION AND UPKREP	
'. In the	course of operation keep the system clean that	
in jood order.	Insure that the outboard fittings are remain-	
Ly secured. Hair	ntain the system in constant readiness for in-	
callate action.		
	B. PREPARATORY STEPS .	
	Initial Position	
2. When the	submarine is at base, outboard valves 2, 5,	
ic, 21 and 23 sh	hould be closed and the depth gauges should	
be wisconnected	with the aid of valves seated on two-velve	
canifolds 3, 6,	9. 11, 14, 17, 20 and 25 (Fig. 2, position II).	
		. X
	Preparation for Action	- 5 ° 9 - 1 ° 5 ° 5 ° 5 ° 5 ° 5 ° 5 ° 5 ° 5 ° 5 °
3. Check th	e depth gauges for disconnection from the	
pipe lines with	the use of the valves seated on the two-	5 년 3 년
ARTAG MEDILOIDS	(position II).	
4. Open out	board valves 2, 5, 18, 21 and 23.	
J. Upen var	ves 1, 8, 13, 22, 25 on the intermediate-	
storyound RIT TID	e and blow the depth gauge pipe lines over-	16.00 6.00 6.00 6.00 6.00
· senior ·		
o. Alter bl	owing the pipe lines close valves 1, 8, 13.	
2 end 25.		
	도 "한다고 다양하는데 한 한다. 도둑 경상 다른 사람들은 그는 사람들은 그를 모양하는데 사람들은 사람들은 사람들은 사람들은 사람들은 사람들은 사람들은 사람들은	Supplied to

# C. STARTING, DIFFER TO TRAVERSE LAIPTEDANCE AND STOPPED

- 7. Cut in the depth gauges by opening the lower valves in the two-valve manifolds (Fig. 2, position I).
- 8. When the submarine is submarged the depth gauges with scales 0-40 m and 0-160 m (depending on the depth of submerence) are cut out by closing the lower valve on the two-valve manifold (position II):
- depth gauges with scale 0-40 m when diving to a depth acceeding 20 m;
- depth gauges with scale 0=160 m when diving to a depth exceeding 110 m;
- (a) to disconnect the depth gauges with scale 0-40 m,
- (b) to disconnect the depth gauges with scale 0-160 m, there the lower valve on two-valve menifold 11.
- 9. Relieve the pressure from the disconnected depth sures (zero reading should be obtained).

To relieve the pressure from the depth gauges, do the following:

- (a) close the respective outboard valve;
- (b) open the upper valve and then the lower one on the two-valve manifold (position IV).

After relieving the pressure close the upper and lower valves on the two-valve manifolds, open the outboard valves and, if necessary, cut in the required depth gauge proceeding as directed by Item 7.

CAUTION! Strictly observe the directions outlined under Item 8 to avoid damage to the depth gauges!

Note: The depth gauges with scales 0-40 m and 0-160 m may be cut in for single measurements (within 10 to 15 sec.) to read the limit values of the scale.

#### D. CHOWNER WAS ENGINEER.

Me.	Symptom or dif- ficulty	Contition may be due to	Correction
1	Depth gauge will not read change in depth	Depth gauge de- fective	Replace dopts Sause
2	Depth gauge pro- duces incorrect readings	Pipe line clog- ged	Blow pipe line
3	Cutboard valve, depth gauge valve, air valve leaky	Gland packing defective	Tighten up gland or re- place gland packing
4	Union connection leaky	Joint untight	Tighten up pipe union or re- place gasket

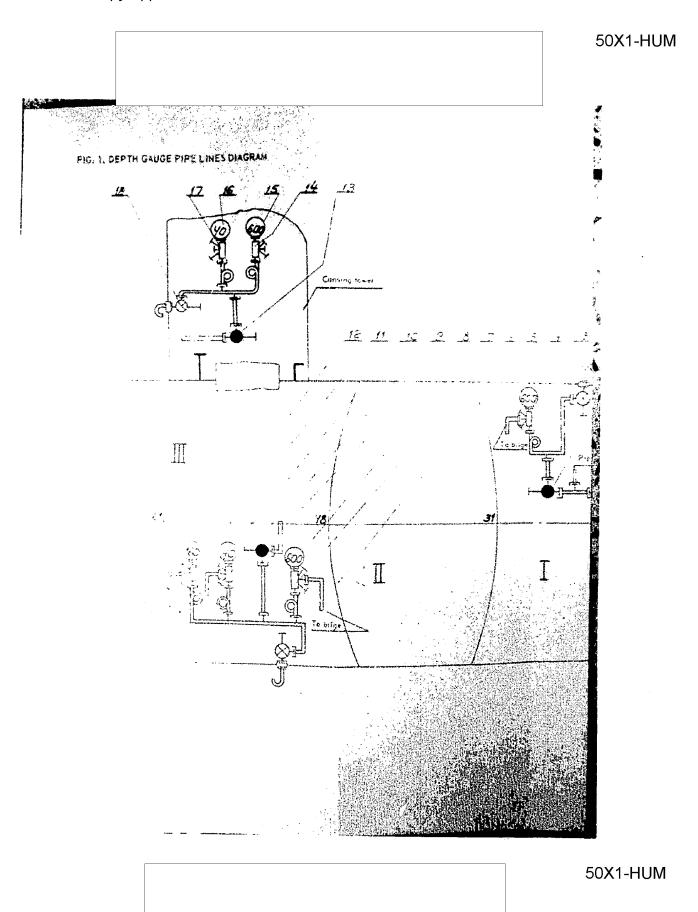
## E. PREVENTIVE MAINTENANCE AND REPAIRS

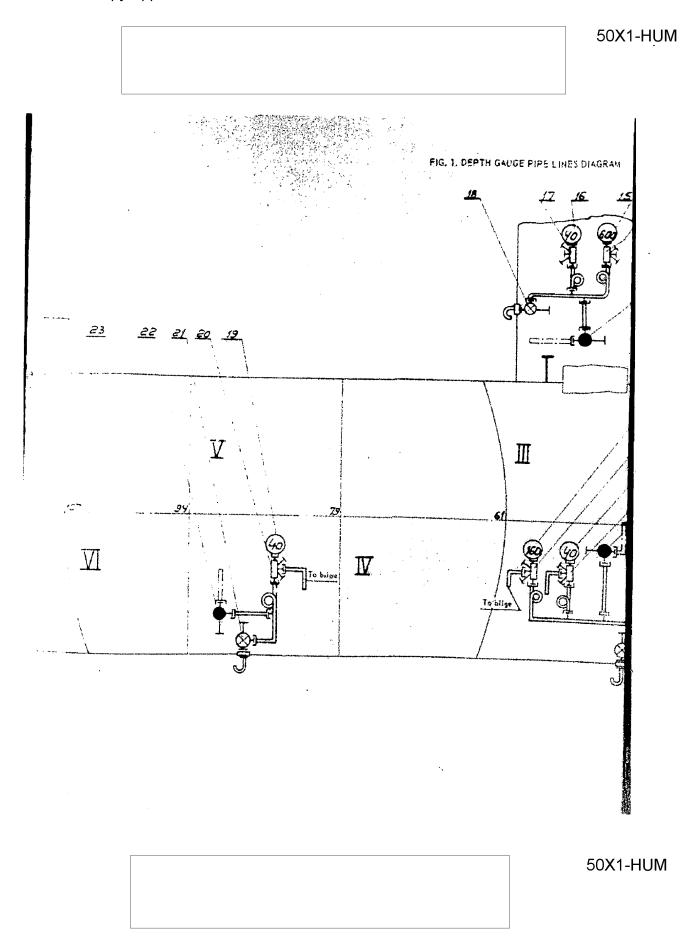
### Inspections

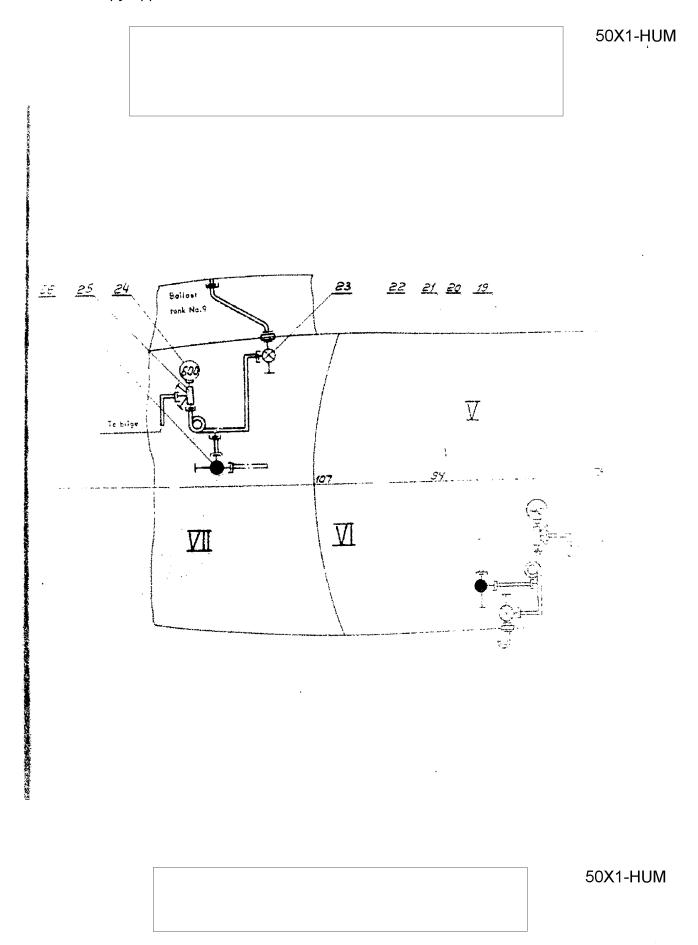
15. Daily perform an external inspection of the system, clean and wipe the fittings, work out all the valves; check the gland packing of the valves for condition; tighten up or replace it, if necessary.

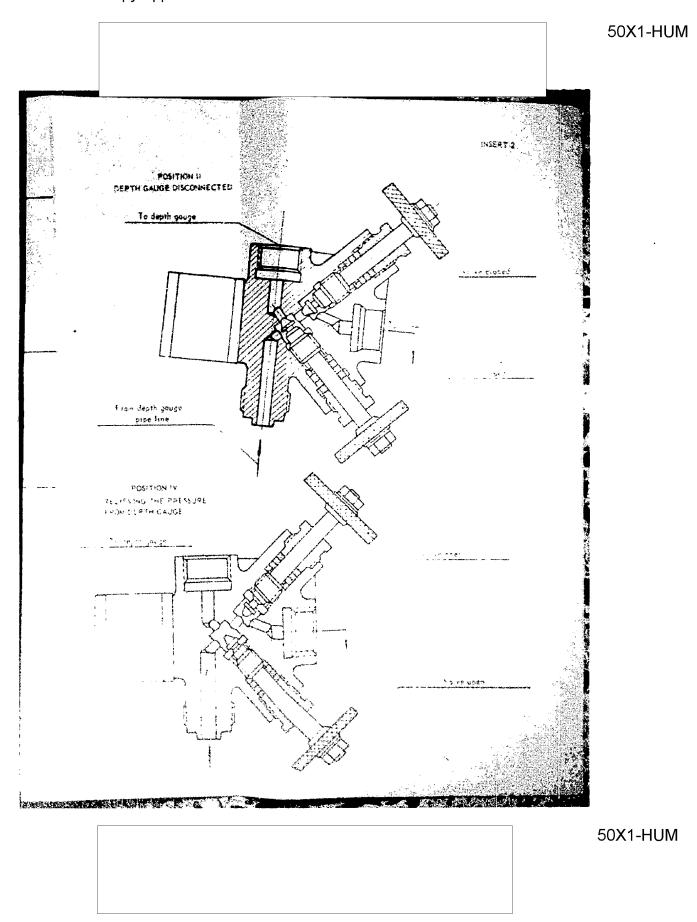
16. Once a year subject the depth gauges to test check.

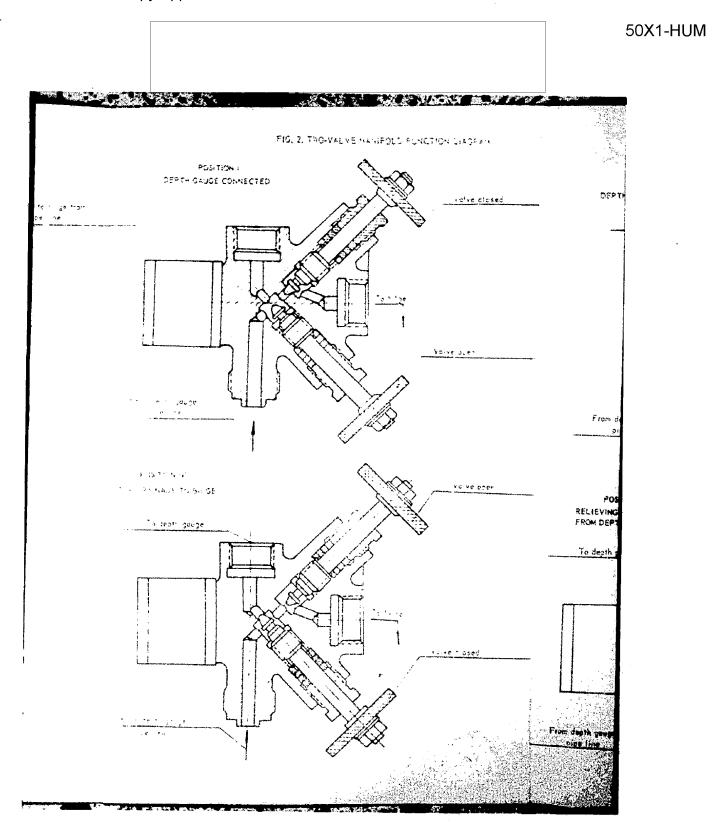
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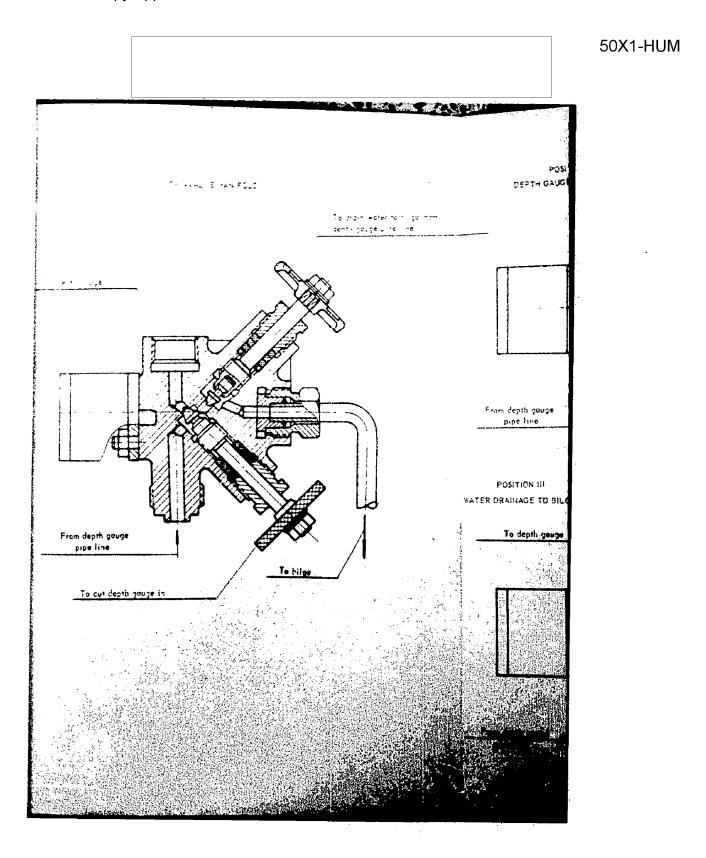




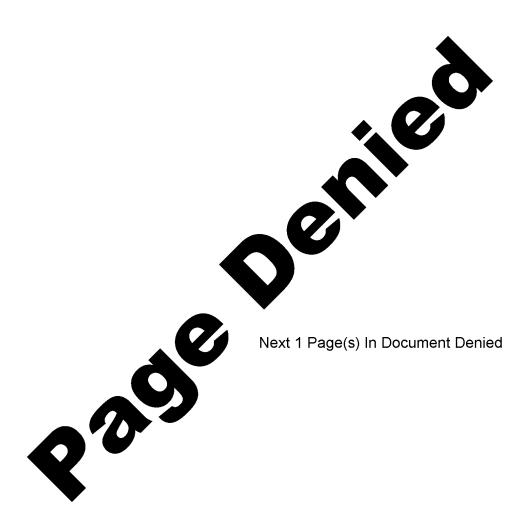


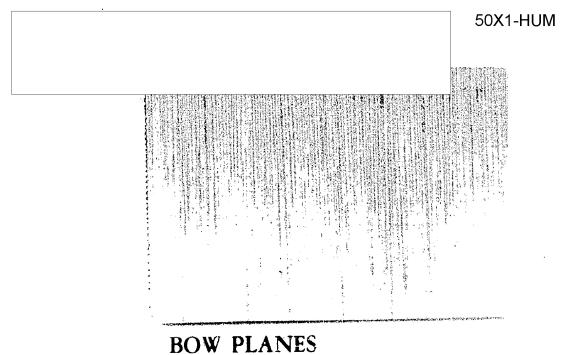






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## DOW PLANES

Description and Maintenance Instructions

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1	. DESCHIPTIO	N		
å	. PURPOSE AND BASIC SI	PECIFICATIONS		
er the lepth) firing w lying lyith,	he bow and the stern parties in a vertical place well as to keep he within the whole rangues the submarine is a trim condition, as we the bow planes shall ones are rigged in, ring with the aid of the	tane (to keep the shi er from broaching dur se of submerged speed running in the full b ell as when rising fr be rigged into the se gged out and tilted	p at a preset ing torpedo s. uoyancy and om the periscope uperstructure.	
Z.A.	Sic Specifications			
12.7d-03	rea of bladee er angles for tilting eg and surfacing	the planes for	6 m <sup>2</sup>	
plane Time no Kaximum Maximum oount	cessary for hard-over s from diving to surfacessary for rigging the pressure of oil in the weight of the set (to for mounting and dist	he planes in or out he oylinders	18-20 sec 16-18 sec 100 kgf/om <sup>2</sup>	
manua manua	nes may be operated hi	ydraulically and	4819 kg	
manua	nes may be operated hi	ydraulically and	4819 kg	
manua B.	nes may be operated hy lly. CEEELAL DESCRIPTION A	ydraulically and	4819 kg	
manua  i.  i.  in  inc blac  for til  bets in  Pir	nes may be operated hilly.  CEEELAL DESCRIPTION A OF INDIVIDUAL UNITS	draulically and and allower (see Pig. 15) of dearine wings and the out the planes. Ith an independent to the tilting shaft of the tilting shaft.	onsists of t mechanisms ilting shart bearing.	
manua  i.  i.  in  inc blac  for til  bets in  Pir	nes may be operated hy lly.  CEEEBAL DESCRIPTION A OF INDIVIDUAL UNITS  General Description  forward set of the pries arranged on the suring and rigging in any blude is equipped which thrust bushings outed on the free end o	draulically and and allower (see Pig. 15) of dearine wings and the out the planes. Ith an independent to the tilting shaft of the tilting shaft.	onsists of t mechanisms ilting shart bearing.	
manua  i.  i.  in  inc blac  for til  bets in  Pir	nes may be operated hy lly.  CEEEBAL DESCRIPTION A OF INDIVIDUAL UNITS  General Description  forward set of the pries arranged on the suring and rigging in any blude is equipped which thrust bushings outed on the free end o	draulically and and allower (see Pig. 15) of dearine wings and the out the planes. Ith an independent to the tilting shaft of the tilting shaft.	onsists of e mechanisms liting shart bearing. is the socket Lanes rigged	50X

out). Rod	l connects the tiller	with the tiller of	the vertical	
shaft of h	draulic tilting motor	7 installed on th	e ceiling of	
No.I compa	rtment. The tilting sha	aft bearing togeth	er with the	
<del></del>	aft and the blade rots:			
	t frame bearing when r			
	g is turned by hydraul:			
_	No.I compartment with		•	
	nges the bearing cage t			
	rods as well as with th		•	
	the tiller of the ver			
	tor. When the bearing of			
	g shaft leaves the rece	-		
	along the ero-shaped gu	uide with U-shaped	section	
	the support frame. ertical shafts of both	the atreasing mate	mir ones donnésia	
	e pipes 4 and 5 secured			
	re hull and packed with			
	lanes are tilted, rigge		_ •	
	oh direct the oil from			
	to the corresponding o			
	it from the other cylin		<del>-</del> -	
	strol valve is sited in			
	ve, in No.I compartmen		,	
To loc	ck the planes in the ne	utrel position, w	nich is	
required be	fore rigging them in a	o that the planes	of the	
	uld coincide with thos			
the arc-sha	ped guides, as well as	to lock them in	the rigged	
cut positio	n, the drift stops wit	h screwed drives a	re provided	
	ring motors.			
THE ME	chanical looks install	ed on the support	frame	
one survey	planes from tilting t	brough an angle ex	cceeding 25°.	
to lead the	l fairleads are wolded mine ropes.	to the blades of	the planes	
and the contraction with the	mana auguss	•		
			No. 1 14 14 14	
		×.	19 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	

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## 2. Description of Individual Units

#### (a) Tilting and Rigging Drive

This is installed (see Fig.2) on the seating in the superstructure and consists of bed frame 1, bearing with tilting shaft 2, tilting drive tiller 3, arc-shaped guides 7 and rigging trive guide 9 with rigging rods 8.

Bed frame I serves to mount all the units of the drive and is equipped with two vertical bearings for the journals of the tilting shaft bearings. Two bronze supporting bushes 5 are pressed in each bearing cage.

Blade 1 (see Pig.3) is of a welded construction and is provided with stiffeners to ensure adequate rigidity. Welded to the stiffeners is hub 2 to connect the blade with the cone of the tilting shaft through a key and cap nut 3. Access to the nut is gained through a portable plate provided on the blade plating. Put on nut 3 is a washer bolted to the hub and used as a rest for the nut when precsing out the tilting shaft from the blade in case of repair. A locking plank welded to the washer is provided for stopping the nut.

filting shaft 4 is held in two support bushes of tilting shaft bearing 5 rotating on a vertical journal. The end of the tilting shaft opposite to the blade with socket 6 fitted on it is connected, with the planes rigged out, with the recess of the tilting drive tiller. Axial displacements of the tilting shaft in the bearings are limited with nut 7 screwed on the tilting shaft and with the bead provided on the shaft.

The cage of tilting shaft bearing 5 has a vertical journal in its lower portion.

Bearing 2 (see Fig.2) of the tilting shaft is placed with its journal in supporting bushes 5 of the bearing of bed frame 1 and is prevented from vertical motion with nut f screwed on the end of the journal.

The bearing cage of the tilting shaft has an eye to connect the fork of rigging drive red 8.

Tiller 2 (see Fig.4) of the tilting drive with a brass journal welded on it is held in shell 4 of support bearing 1, 2 located in the middle of the bed frame.

The tiller webs have recesses for housing the so	okets or
the planes. The friction surfaces of the recesses hav	경우 1일 그렇지 수 하시는 회에 사회 가장면 경험되었습니다.
layer welded on them.	
The tiller is connected with the rod of the tilt	ing drive
through steel pin 5 provided with limiting bushes and	instal-
led in the webs. When tilting the planes through an a	ngle of
±25°, the lower portion of the tiller rests against m	echanical
responsible (see Fig.2) mounted on the bed frame. The rad	ial bear-
or of the tiller consists of cage 1 (see Fig. 4), cov	er 3 and
tree shell 4 composed of two parts.	
The lower part of the shell is kept from rotatio	n in the
are with the aid of two round pins.	
Arc-shaped guides 7 (see Fig.2) which are U-shap	ed in seo-
tion are mounted in the fore portion of the bed frame	and are
and to direct the sockets of the plane tilting shafts	s when
rigging them in or out. The salls of the guides are s	trengthen-
with stiffeners and are equipped with brackets to	
them. A layer of brass is welded on the inner horizon	tal surfa-
ces of the guides.	
The guide of the rigging drive (see Fig.5) is use	
direct the motion of the slide connecting the tiller of	of the
hydraulic rigging motor to the turning bearings of the	e tilting
chafts. The guide consists of two brackets 1 attached	to the
bed frame, guide rods 2, slide 3 with forks in the end	is to con-
neet rigging rods 8 (see Fig.2). Pressed in the slide	are
bronze guide bushes to receive the pin of the rod of t	the hydrau-
lic rigging motor and the guide rods. Travel of the sl	lido along
the guides is limited by half-rings 4 secured to the t	rackets.
Centralized lubrication of all the friction parts is e	effected
from the pressure hull with the aid of the pressure lu	ibricator
and the lubrication distributors.	
(b) Tilling and Rigging Motors	
The tilting meter (see Fig. 6) consists of a body,	evlindera.
The state of the s	A 4.4 7 3 mm
The standard with the first and the second second	
a constituent of them to the gentler than	
lower portion of the body are: a locking device, a bea	ring of the

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vertical shaft with a cover and a bronze shell composed of	
parts, mechanical rudder indicator 7 and two screws 6 with	
lackmuts to set the plunger of the motor to the neutral po-	
tion through rest 5. One part of the lower bearing shell is	
held on the body with a pin.	
The side longitudinal wall of the body has recesses f	,
housing oup lubricators intended for lubricating the block	
Connected to the face surfaces of the body are cast steel	
linders 2 with collars for packing plunger 3 and with limi:	ting
buts with felt dirt control rings. Direction of the plunger	r
motion in the cylinders is ensured with bronze liners. The	
cylinders have openings for feeding and draining oil and fe	or
bleeding the air.	
Plunger 3, flat in the centre, is connected with lever	r 12
of the tilting motor through the journals of two bronze	
blocks 11. The journal of the lower block has a taper socke	et for
housing stop 13 of the locking device.	
Lever 12 is coupled with vertical shaft 8 by means of	two
keys. The upper end of the vertical shaft extending from the	
pressure hull mounts tiller 9 secured with two keys and a 1	
ing nut. The tiller has pin 10 to secure the tilting drive	
The shaft of the tilting motor with bronze jackets fit	
on it rotates in the guide bushes of the base pipe mounted	
the flanged weld-on of the pressure hull and rests against	
supporting plane of the upper bush of the base pipe through	
tiller hub and the adjusting ring. Nut 14 screwed on the lo	
and of the shaft and resting against the bead of the lower	· · · · · · ·
bearing shell prevents the shaft from vertical displacement	÷s.
The upper part of the shaft has an eye meant for transporta	
purposes.	· v um, 17 4#
The inscription plate of the mechanical plane tilt ind	1 mar
eater and toothed sector 4 of the transmitter drive of the	· <del></del>
electrical plane tilt indicator are mounted at the lower an	લો
upper portions of the lever hub, respectively.	•
The Locking device intended for stopping the lever com	pri-
ses the following principal parts: a spindle with a taper t	~
a cover with threaded hole to receive the spindle and the	*
bandwheel with the stop position indicator.	
• •	
	7
	50X

		4 1			
50	X'	1 –	н	U	IV

The friction surfaces of the shell and of the blocks of the lever are lubricated with our lubricators.

The rigging motor (acc Fig.7) differs from the billing motor in smaller sizes, in construction of tiller 1 and the looking device. This motor is not provided with screws for while, the lever to the neutral position; it has no toothed with of the transmitter drive, but it has a contactor of the passes of the planes and its drive.

Titler 1 of the motor is connected with the fork of the

The locking device has a cylindrical tail of step 2 which will use a real for the special projection on the motor lawer than the regged out position.

lettric contactor , is installed in the lower portion of the tody of the motor and when vurning the lever, the rod of the little for the process 4 secured on the hub of lever to

#### The second second of the second

with its flange to the weld-on of the pressure hull. Guide bronce bush 2 and wain bush 3 are pressed into the upper and lover portions of the base pipe, respectively. The base pile boases the gland with a soft packing for sealing the end of the steering motor shaft extending from the pressure bull. Centralized Lubrication of the bushes is effected from the pressure bull.

The base pipe of the rigging drive differs from that of the tilting drive in smaller sizes and in absence of stiffstoom.

#### (d) Rods

All the rods of the tilting and rigging drives are worked in steel pipes with the heads welded to them. Support have thenes are pressed into the holes provided in the heads of the times are pressed into the holes provided in the heads of the times are rods which move in the same plane. The angularity the time drive axes which is caused by its motion in two times is compensated with ball shells 3 of the rod heads the rike. The objected true the pressure hull.

	50X1-HUN
(e) Control System	

#### (e) Control System

The bydraulic steering actors used for tilting and rigging the planes are connected with the hydraulic system (see Pig.12) through the control valves, reducing valves and shut-cif valwest, with the help of the respective control valves the plumgers of the steering motors may be set to any required position to ensure tilting the planes for diving and surfacing, as well so rigging them in or out. With the handle of each central value in neutral, the respective steering motor gets discenrested from the hydraulio system.

The control valve of the tilting drive (see Fig. 10) is assised in the control room, starboard. Housed in body 1 is iner 2; four pipe unions to connect the pipe lines being also installed there.

Rod 3 with raked fields communicates the spaces of the cylinders of the tilting motor with the supply and return pips lines, or whom in mentral, shuts off the supply to the cylinders.

The raked fields of the rod of the control valve secure smoother opening of the passage area.

The control valve is operated with the aid of handle 4. The axle of the control valve is looked in the neutral position with pin 5.

The control valve of the rigging drive (see Fig. 17) is sited in No.1 compartment. Pressed in body 30 is bush 29 in which slide valve 28 enters. The slide valve moves with the eld of toothed cam 25 fitted on spindle 25 coupled with handle 31. The spindle is packed with the body through rubber rings. The body is closed with covers 27,

Pastened to the lower portion of the body through the use of nut 24 is cover 20 incorporating valve 22. The valve is pressed against saddle 23 by spring 19.

The cover and the saddle of the valve are packed with rubber rings.

When turning handlo 31, slide valve 28 starts chifting thus communicating one of the pipe unions TO THE SERVICES with the centre cavity of the control value (1.c. the supply eavist)

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and the other pipe union with the face cavity, i.e. with the	
return osvity.	
Simultaneously cam 26 actuates valve 22 and opens it, ti	ius
communicating the centre cavity of the control valve with the	
supply pipe line.	
With the handle of the control valve in neutral, the sl	ide
walve disconnects the pipe union TO THE SERVICES, while valve	3 22
spects the control valve from the supply line.	
1 1 the Oil System	
correlised lubrication system is provided for the out-	
" lotion parts of the tilting and rigging drives (see	

Imbe oil is fed to the points to be lubricated by opening in turn shut-off valves 14 and 15 (see Fig.16).

controlized lubrication is effected with the help of the ressure lubricator (see Fig.14) sited in the fore comparts through two lube oil distributors (see Fig.13) mounted on the calling of No.1 compartment in the area of frames 17-18. The lube oil is distributed among the friction parts by turning the handwheel of the distributor to a position shown by the

## 3. Auxiliary Mechanism

or druction plate.

Sited on the cross-connection of the pipe lines running to the cylinders of the tilting motor is a by-pass safety valve (see Fig.11). It is intended to protect the drive of the planes and the hydraulic pipe lines from considerable incidental loads soting on the blades.

The valve consists of body 1 with liner 2 of rod 3, discs 4, springs 5 and muts 6. When pressure in one cylinder exceeds the permissible value, the rod starts moving in the liner, thus compressing the spring, as a result the grooves on the rod communicate both the cylinders and pass the cil from the cavity with increased pressure to the other cavity. The apring of the valve is adjusted for a pressure of 110-125 kgf/cm<sup>2</sup>.

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4. Control Instruments	
4. Control lustruments	
The electrical indicator mounted in the control room sho	<b>V</b> S
the position of the planes, the pulses being received from th	
alsotrical indicator transmitter. The spindle of the transmit	
ter is moved by the vertical shaft of the tilting meter.	V
The rigged in or rigged out position of the planes is	
indicated in the control room and in No.1 compartment by ligh	t
signals with the help of the electric contactor mounted on the	
rigging motor.	
Mechanical indicators mounted on the tilting and rigging	
motors are used to watch the position of the planes from No.1	
compartment.	
The pressure gauges installed on the hydraulic pipe line	3
at the planesman in the control room show the pressure in the	
bydraulic system.	
The supply pipe line mounts a pressure gauge with a mea-	
surement range of from 0 to 160 kgf/cm2 with the red line	
against 100 kgf/cm2 (working pressure).	
The return pipe line mounts a pressure gauge reading a	
pressure of from 0 to 60 kgf/cm2 with the red line against	

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II. MAISTENANCE INSTRUCTIONS
A. GENERAL SUPERVISION AND UPKERP
In the course of operation keep the steering system in
good order and in constant readiness for immediate action, for
which purpose do the following:
1. Subject the whole system to external inspection.
2. Check the gland packings of the steering motor plungers
and the packings of the control valve rods for leaks.
3. Ensure that the friction surfaces are properly lubricat-
A Property of the Control of the Con
4. Check the rigging and tilting systems for condition by
semparing the readings of the mechanical and electrical indica-
tors.
5. Perform preventive maintenance and scheduled inspections
proceeding in accordance with the directions outlined under
Section II-E and Sections II-B and II-C.
6. When diving, check the gland packings of the steering
motor vertical shafts for leaks.
7. Care should be taken that no foreign articles are allowed
to be present in the vicinity of the movable parts of the system

- 8. Check attachment of the mechanisms to their seatings.
- 9. Check to see that no air is present in the hydraulic system of the steering motors.
  - 10. Keep the name plates in good order.
  - B. PREPARATORY STEPS
  - 1. Initial Position
- Il. Check that all the parts of the system are in the initial position:
  - (a) the planes are rigged in;
- (b) the lock of the tilting motor is in the ON position, while the lock of the rigging motor, in the OFF position;
- (c) the handle of the tilting control valve is in neutral and is looked with a pin. The handle of the rigging control valve is in the neutral position:

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- (d) valves 1, 3, 6 (see Fig.12) on the supply and return pips lines of the hydraulic system, as well as shut-off by-pass valve 4 on the pips line of the tilting motor are in the SHUT position;
- (e) the mechanical indicators on the steering motors and the electrical indicator seated in the control room read zero. Check the system as a whole and make sure that it is in good order.
- 12. Carry out all the procedures dealing with preparing and putting into action the hydraulic system proceeding in strict adherence to the instructions for maintenance of the system.
- 13. Check the pressure of the working oil in the hydraulic system by the pressure gauge in the control panel which shall be within 77-100 kgf/cm<sup>2</sup>.
- 14. See to it that the lock of the tilting motor be in the LOCKED position, while the lock of the rigging steering motor in the UNLOCKED position.
- 15. Open shut-off valves 1, 3, 6 (see Fig.12) on the supply and return pipe lines of the hydraulic system.
- 16. Use control valve 5 to rig out and rig in the planes to check the drive and the light signalling system for operation.
- 17. Rig out the planes and make sure that this position of the planes is shown by the light signal in No.I compartment and by the mechanical indicator, set the look of the rigging steering motor to the LOCKED position, shift the handle of control valve 5 of the rigging drive to the neutral position and close valves 6 on the hydraulic pipe lines feeding the oil to the control valve.
- 18. Set the lock of the tilting motor to the UNLOCKED position.
  - Note: Every time before rigging the planes out, lubricate arc-shaped guides 7 (see Rig.2), and before rigging them in lubricate two points of tiller 3.
- 19. Remove the pin locking the handle of control valve 2 (see Fig.12) of the tilting drive.

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Note: To prepare the rigging and the tilting drives for action, strictly observe the directions outlined under this Section.	
C. STARTING, DURING-OPERATION MAINTENANCE AND STOPPING	
Starting 20. By the light signal in the control room make sure t	iha t

- the planes are rigged out.
- 21. For tilting the planes turn the handle of the control walve of the tilting drive down when diving and up when surfacing. Watch the position of the planes by the electrical indicator. After the planes have been tilted through a preset angle, set the control valve to neutral.
  - C A U T I O N: The planes shall not be tilted through an angle exceeding  $\pm 25^{\circ}$ .
  - Note: Difference in readings of the mechanical and elsctrical indicators shall not exceed ±2.56.

#### During-Operation Maintenance

- 22. See to it that the planes and the control system be in good order; give special attention to packing of the plungers of the steering motors, the rod and the piston of the control valves and of the vertical shafts of the steering motors.
  - 23. Lubricate all the friction parts in due time.
- 24. In case the hydraulic system gets defective, bring the planes to neutral (if they were tilted for diving or surfacing) manually with the aid of screws 6 (see Fig. 6) mounted on the tilting motor.

But before doing so, open shut-off by-pass valve 4 (see Fig.12) used for by-passing oil. Under any other operating condition of the drive valve 4 shall be shut.

CAUTION! 1. When the submarine is running in full buoyancy or diving trim condition, as well as when surfacing from the periscope depth, the bow planes should be rigged into the superstructure.

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	A 111	
2. No not bring :	the planes to neutral with	
the aid of the screws on trunning speed of the subm	the tilting moter if the	
25. When tilting the planes wat	oh the pressure of oil in	
the hydraulic system by the pressure	gauge of the centrol panel.	
At a pressure of oil of 70 kgf/cm2 w	hich keeps on dropping, or	
in case the red lamp lights up on the	e hydraulic system alarm	
board in the control room, perform the	he directions outlined un-	
der Item 24 of this Section and rig	in the planes with the help	
of the hand-operated pump installed	in Ho.I compartment.	
Stopping		
26. After completing operation	with the planes, return the	
planes to neutral using the control		
27. Watch the mechanical indica		
planes are in neutral and set the lo		
the LOCKED position. By-pass walve 4		
shut after looking (see Fig.12).		
28. Open valves 6 on the hydrau	die pipe lines feeding oil	
to the control valve of the rigging		
29. Set the look of the rigging		
position.		
30. Shift the handle of control		
OUT position and rig in the planes.		
are rigged in as indicated by the me		
the handle of the control valve to n		
31. Shut valves 1, 3, 6 on the	supply and return pipe	
lines of the hydraulic system.		
D. TROUBLES AND REMEDIES		
32. Given below is the Table of	troubles and corrective	
measures to be taken to eliminate th		
	$\mathbf{S}_{\mathrm{total}}$ , $\mathbf{S}_{\mathrm{total}}$	
	ta in garage and a second	
		50X
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No.	Symptom or dif- ficulty	Condition may be due to	Correction
1	Oil leaks through packings of plun- gers of tilting and rigging motors and control valves	Packings defec- tive	Replace defoc- tive collars and packing rings
2	Mechanical and electrical tilt indicators produce different readings	-	Disengage toothed wheel of transmitter from toothed sector of tilting motor and
			by turning shaft of transmitter align electrical tilt indicator with mechanical tilt indicator on tilting motor. In this position engage toothed wheel of trans- mitter with toothed sector of
essessif Vance-verse Systems	Water leaks through glands of vertical shafts of steer- ing motors	Packing loose or defective	tilting motor  fighten up res- pective gland or replace packing (only when on surface)

## S. PREVENTIVE MAINTENANCE AND REPAIRS Daily Inspection

33. Perform an external inspection of the principal units of the system arranged inside the pressure hull and make sure

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	they are in good order and no foreign matter is on the way
of ti	ue movable parts.
	34. When the sub is at anchor, check the steering system
for (	condition by rigging out and tilting the planes for two
timen	when doing so make sure that the light alarm correctly
.uo#8	the position of the planes; the mechanical and electrical
	indicators produce the same readings, misslignment in
theli	readings within ±2.5° being permissible.
	Weekly Inspection
	Perform the procedures of daily inspection and in addition
1 02 1.1	te following:
	35. Inspect and clean all the units of the system arranged
oter anto sec i	de the pressure hull.
6.02 6.03 3	36. Lubricate the units of the steering system from the
aantr	ralized lubrication system and with the aid of the cup
	icatoras
~ 16 8/ £ 2	37. Lubricate minually the toothed wheel of the electric
e 2 7 4	-
	indicator transmitter, the axles of the control valve
ea no.	les, cam and rod of the electric contactor.
	38. Thoroughly inspect all the joints and the fittings of
	lydraulic system and if necessary tighten up the joints and
ETREC	packings of the valves.
	Note: 1. When lubricating the friction surfaces of the outboard parts see to it that the valves between the grease fitting and the lube cil distributors be open, which are shut as a rule.  2. Centralized lubrication of the arc-shaped guides is carried out with the planes in the extreme positions only (rigged in or rigged out).
	Monthly Inspection
	Perform the procedures of weekly inspection and in addi-
tion	do the following:
	39. Check the glands of the steering motor plungers to
na ka	sure that oil does not leak along the plungers.
**	Yearly Inspection
	System Control of the
	40. Ferform preventive maintenance of the mechanisms of
the é	trive as a whole, giving special attention to the parts of
	37.
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the outboard portion of the drive, the threaded jo	inte, faster
ings and chrome-plated surfaces.	
in case some parts are eated away by corrosion	
of other defects to them, they shall be thoroughly	inspected
to make sure whether they are serviceable or not.	
HEVER use threaded parts, bolts, nuts, oc	
and lock washers, if they are corroded. Remove corr	
the parts, clean, prime and paint the surfaces afte	
All the lock washers and cotter pins shall be	
See to it that the fastenings are given a prev	entive coat-
ing.	
Note of replacement of the parts and fastening	s should be
entered in the Log Book,	
Al. Change lubricant in the pressure and oup l	ubricator
and clean all the lube oil openings and channels.	
During-Booking Inspection	
42. Check and align the position of the bow pl	anes with
the mechanical tilt indicator.	
43. Check attachment of the planes; check to B	se that the
units, belted joints and locking parts are in good	
44. Disassemble the outboard portion of the be	
45. Replace gland packings in the staffing tub	as leading
to the pressure hull irrespective of the rate of we	
46. Measure the clearances in the pares of the	friction
units arranged outside the pressure hull. If the cla	earances
exceed the permissible value, repair the parts.	
47. Make sure that lube oil is free to flow all	ong the bipe
and a second sec	Criotian
surfaces which is indicated by the oil entering the	olearances
os and surraces intricated.	
48. Theck the zink protectors in the preximity	of the bow
find the condition,	2. Jan 1. 2011.
if necessary, clean or replace the protectors.	
Meyer paint the protectors.	
Inspection during Running Repair	

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marine; replace worn parts with simultaneously replacing the
rubber collars, rings and peronite gaskets.
CAUTION! Under no circumstances install defective rubber collars and rings (with scores, netches, etc.). Filing the parts to eliminate these defects is never permitted. At no time install unspecified rubber rings, neither use cutting tools for driving the rubber packings into the scokets.
Y. DISASSEMBLY AND REASSEMBLY (in the scope of prevention mointenance)
(in the scope of preventive maintenance and repairs) General
50. In case of complete disassembly of the system, out a section in the superstructure deck.
51. Mark the conjugated parts giving attention to the markings of the shims.
52. Protect from damage the friction surfaces of the units disassembled.
Disassembly
53. Drain oil from the cylinders of the steering motors by
removing the oil drain plugs and the air bleeders. Disconnect
the pipe line and blank off these openings in the cylinders.
54. Disconnect the rods from the tillers and from the tilt-
ing and rigging drives.
55. Disconnect the tilting and rigging drive from the
seating and pull it from the superstructure with the aid of the crane.
Hote: Depending on conditions of disassembly and state of the drive proper, the drive may be disassembled partially, i.e. the ted frame of the drive may be left on the seating, for which purpose proceed as follows: remove the tiller bearing and the turning bearings with the tilting shafts and blades from the bed frame.
56. Unscrew the nut on the lower portion of the vertical
shaft of any steering motor, disassemble the lower bearing and
having disconnected the body of the steering motor from the bed

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be by shifting it to the side opposite to the sha body from the lever keeping the upper block from 57. Use a detachable clamp to remove the lever f ft. Hemove the keys. 58. Remove the pressure bush of the shaft gland pipe, remove the packing and pull the shaft from	falling. rom the
together with the tiller.  19. Futheron, disassemble the units in accordance to the property drawings.  60. All the data on inspections, repair and replace defective parts shall be entered into the log	e with the
enesembly proceed in the order reverse	to dises-
o', in accordance with the drawings appended to the	@ ILStruo-
Prior to reassambly wash all the parts in Resource of lubricant, wips them dry and cost with A tiresh lubricant.	*
62. See to it that the mounting clearance correst indicated in the work drawings of the drives.	Ť
63. After reassembly fill the cylinders of the rors with oil and check them for tightness under a $100 \text{ kgf/cm}^2$ . When charging the cylinders with oil,	pressure

Note: The gaskets and the gland packages of the base pipes shall be tested for tightness simultaneously with testing the hull of the sub for vacuus.

64. Adjust the pressure-reducing valves on the supply lines of the hydraulic system (see the Basic Specifications) to ensure the required time for tilting and for rigging the please in and out.

Adjust the light alarm system for proper operation. 65. After resisonally bring the drive to the initial posttion proceeding in accordance with the directions cathing Practice Salating II.

Co. Shork the whole system for operation in conformity when the lastretions of Section II-C.

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G. HEFERENCE DATA  67. The service life of ars is 3 to 5 years, the ten after this term is up, a castring motors and control to the Working medium to a spiedle oil.  69. All the friction par	rm of storage beali the cellars valves shall be used in the hydronest	ing includ and rings replaced. raulic syst	in the	
69. All the friction paragraph are lubricated with AMC and the pressure bull are	-3 lubricant, w	hile those	arranged	
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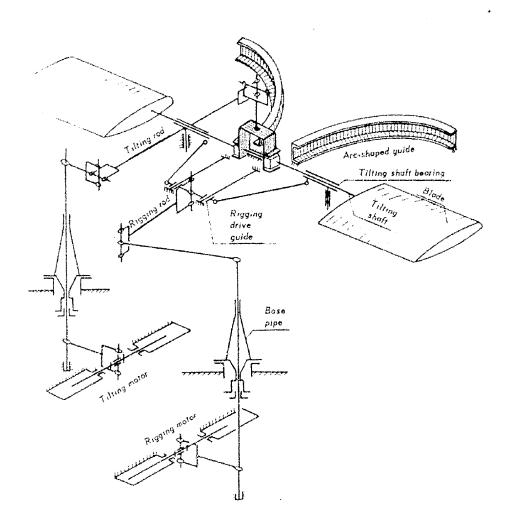
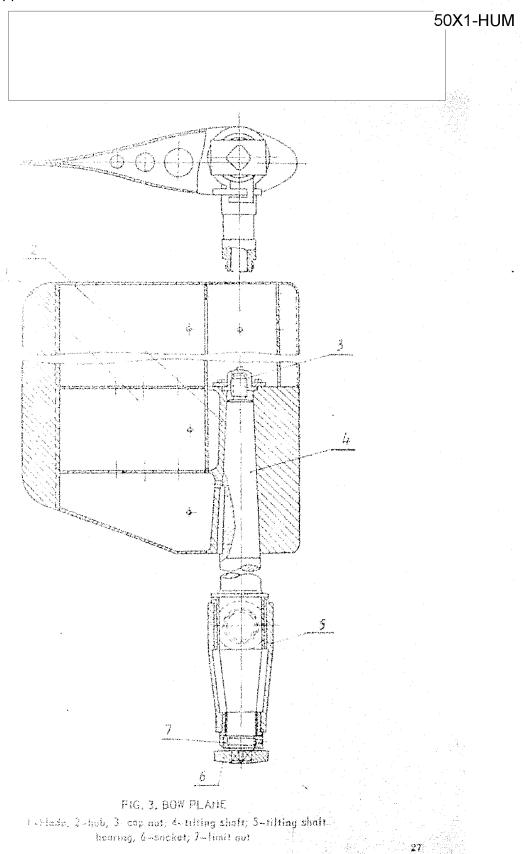


FIG. 1. DIAGRAM OF MECHANISMS OF BOW PLANES DRIVES

i-bed frame, Z-bearing, 3-tilting drive tiller, 4 rest. 5-support bushy 6-nut, 7-arc-shaped guide; 8-rigging rod, 2-rigging drive guide



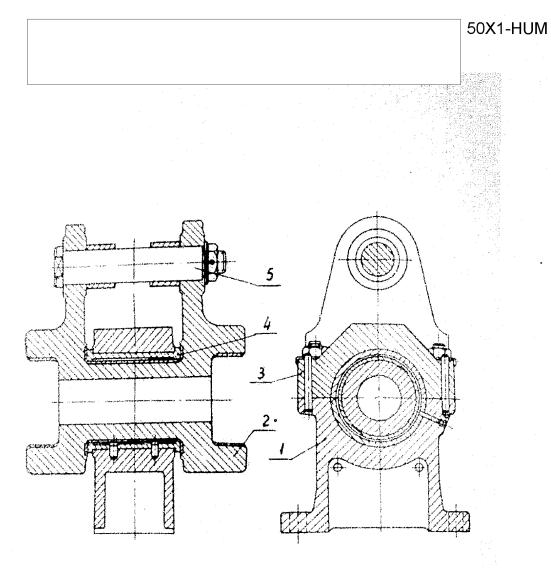


FIG. 4. TILTING DRIVE TILLER
1-bearing cage; 2-tiller; 3-bearing cover; 4-shell (two holves); 5-pin

28.

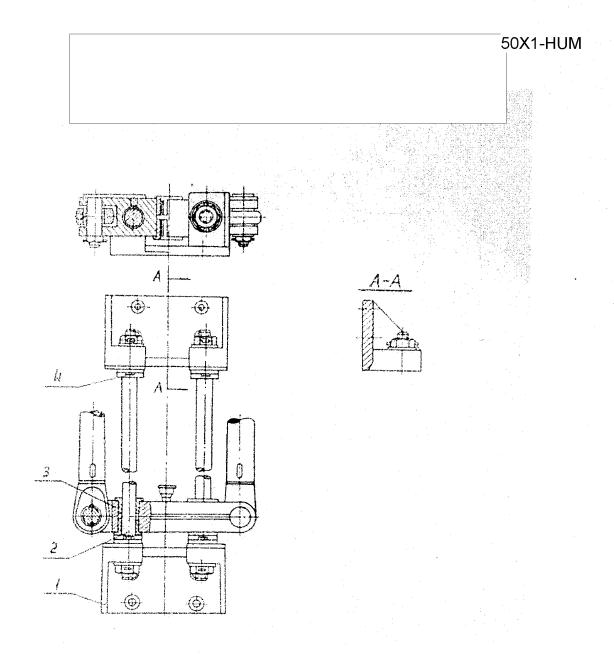
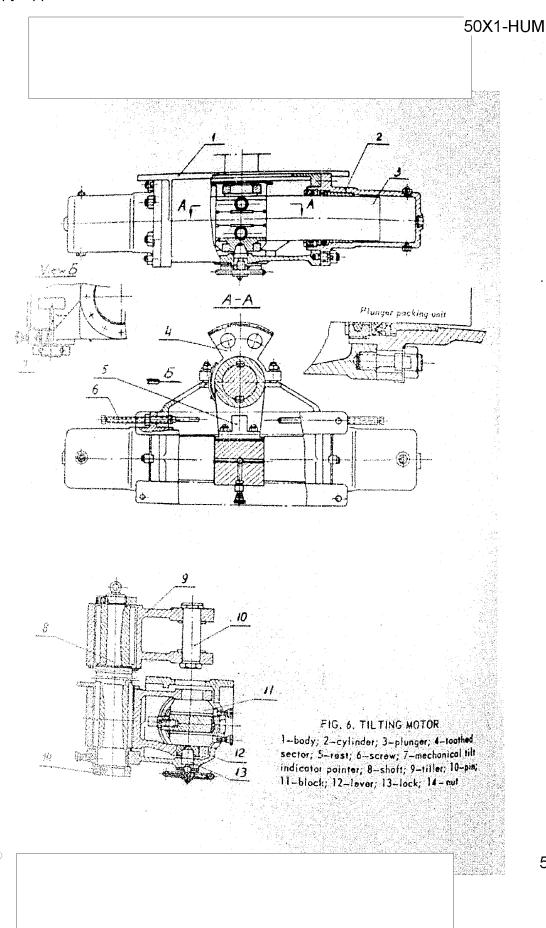
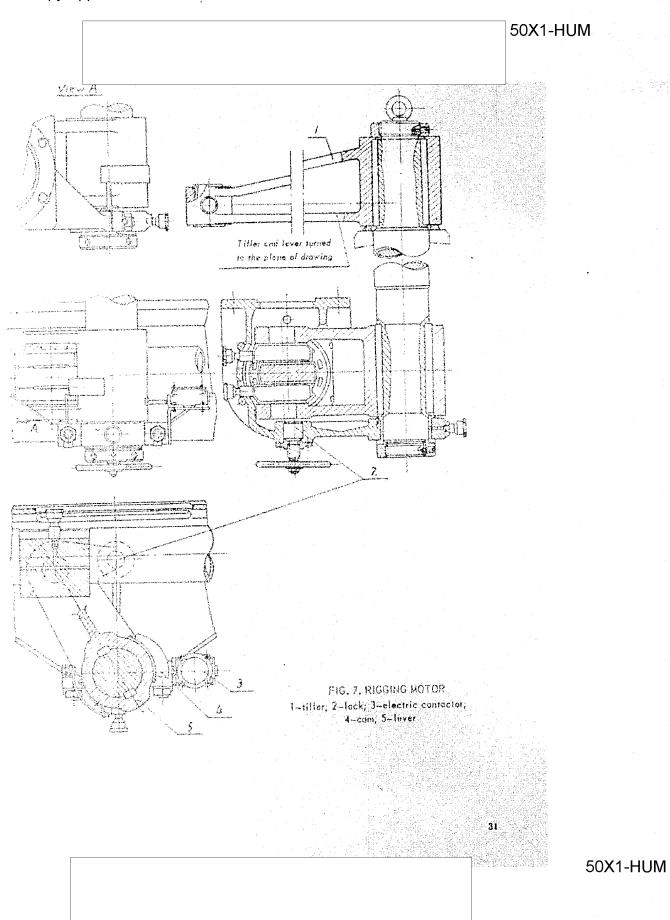
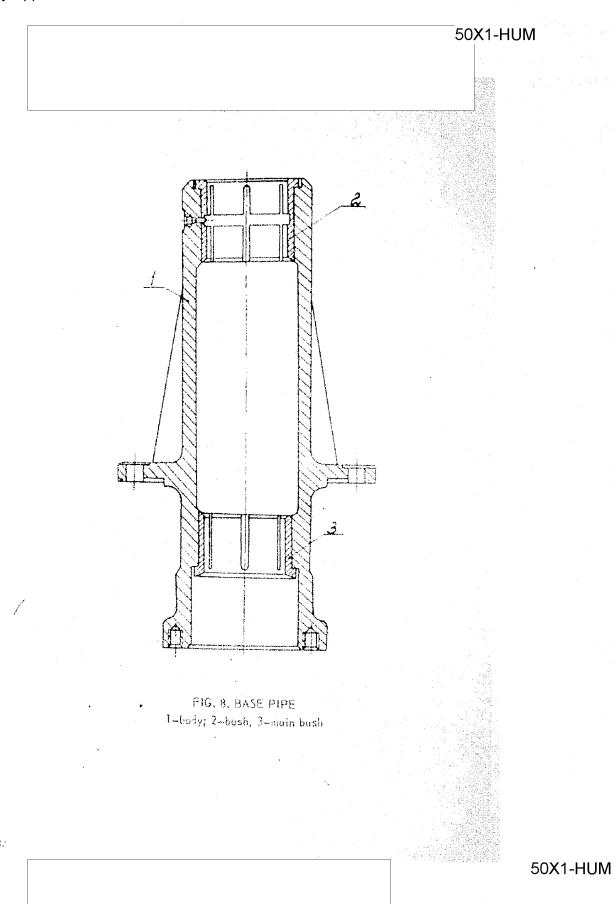
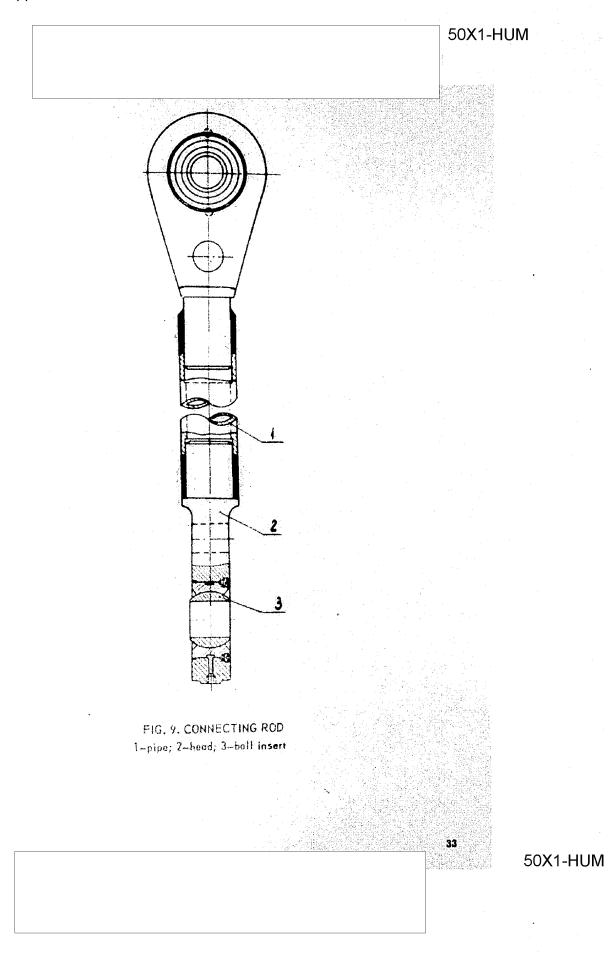


FIG. 5. RIGGING DRIVE-GUIDE 1-brucket; 2-guide rod; 3-slide block; 4-limit half-rings









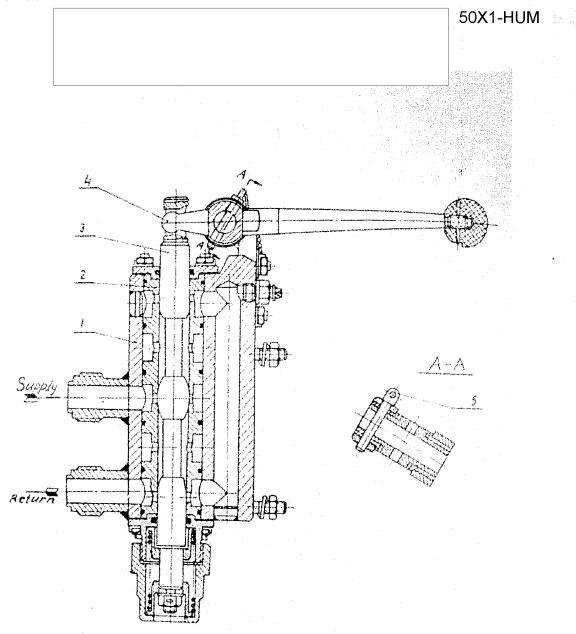
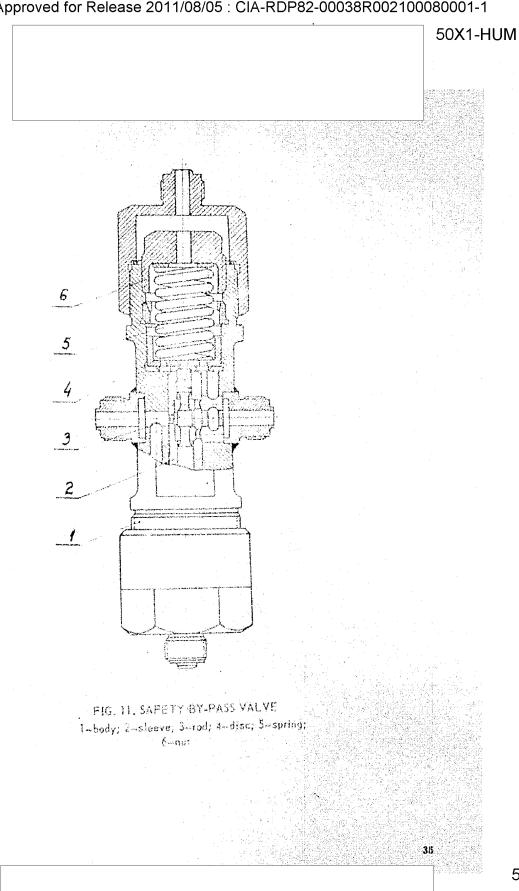


FIG. 10. CONTROL VALVE 1-body; 2-sleeve; 3-rod; 4-handle; 5-pin

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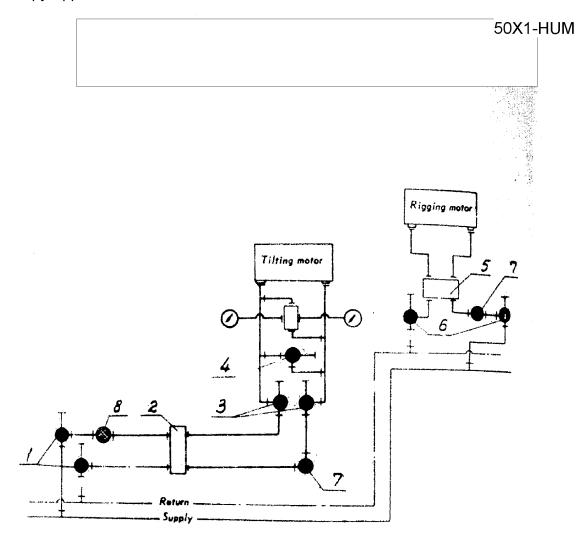
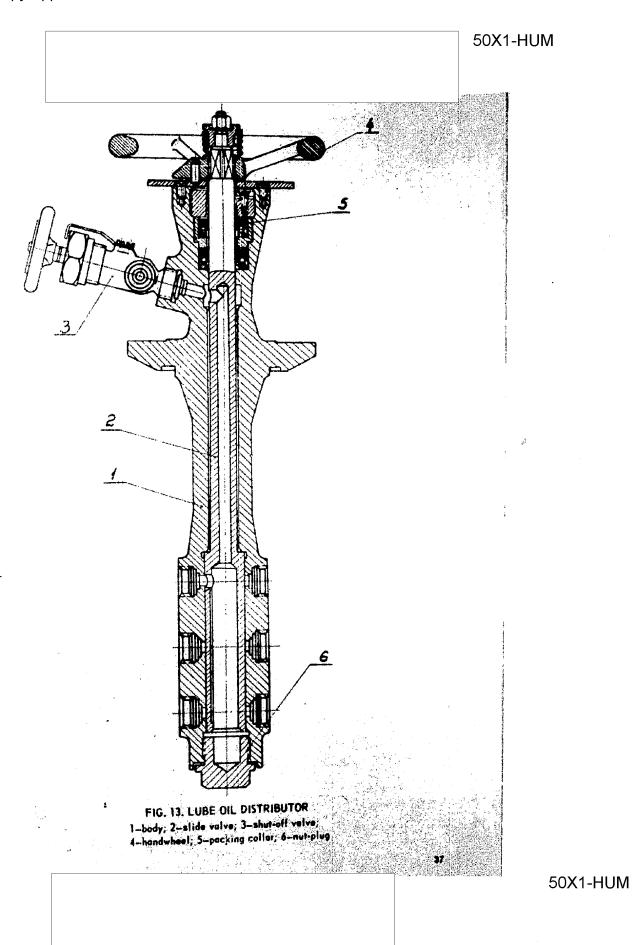
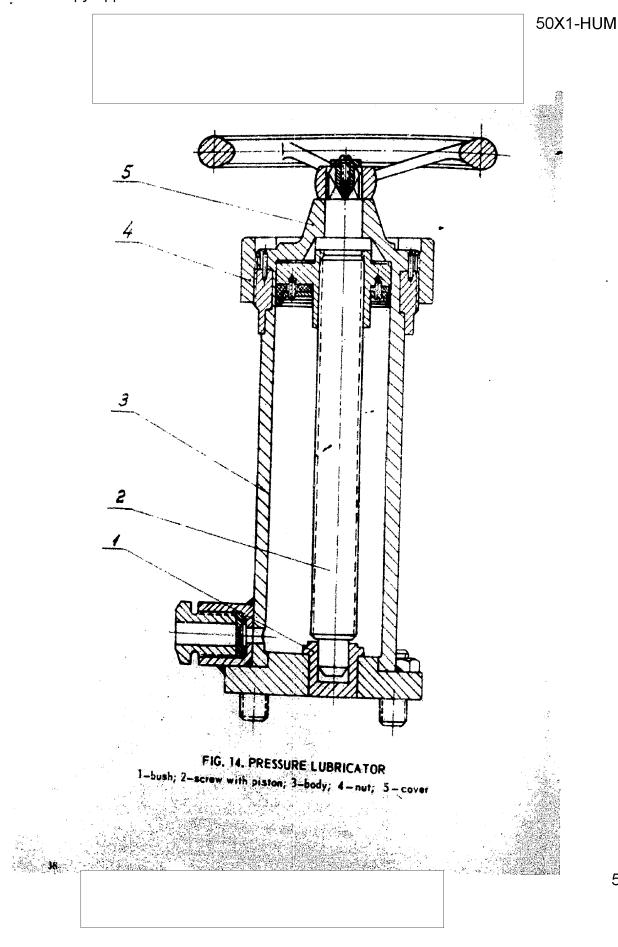


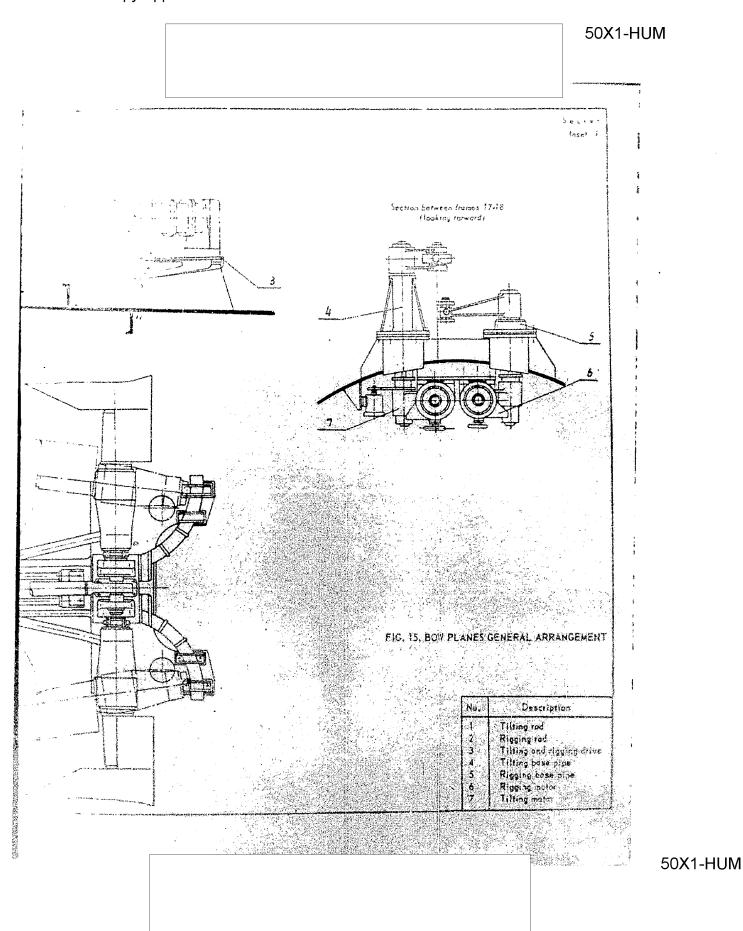
FIG. 12. CONTROL SYSTEM

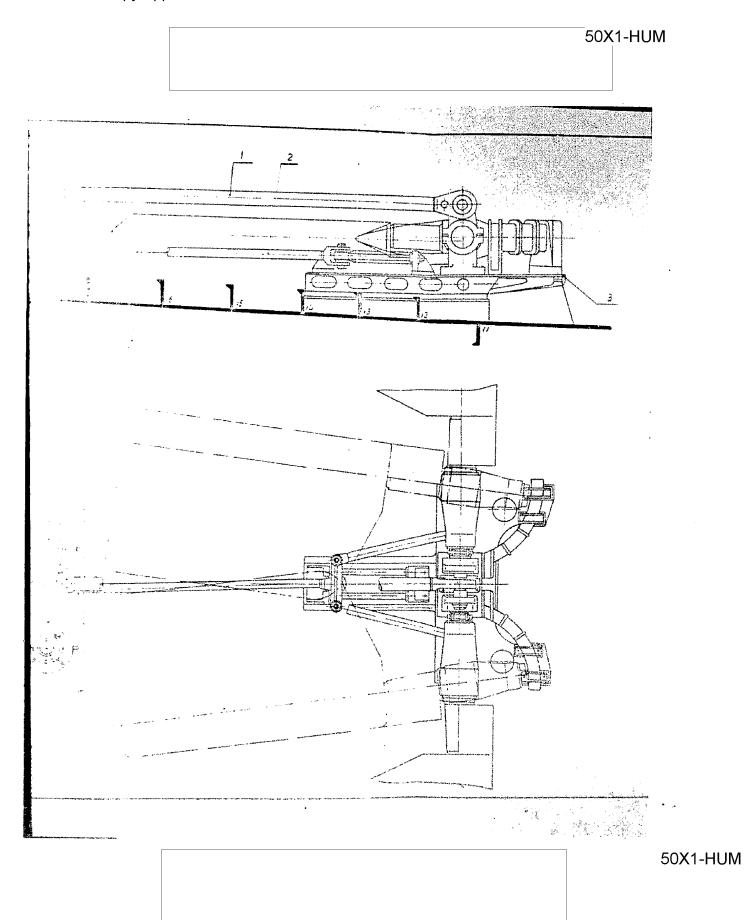
1-shut-off valves; 2-tilting control valve; 3-shut-off valves; 4-shut-off valve; 5-rigging control valve; 6-shut-off valves; 7-pressure-reducing valve; 8-strainer

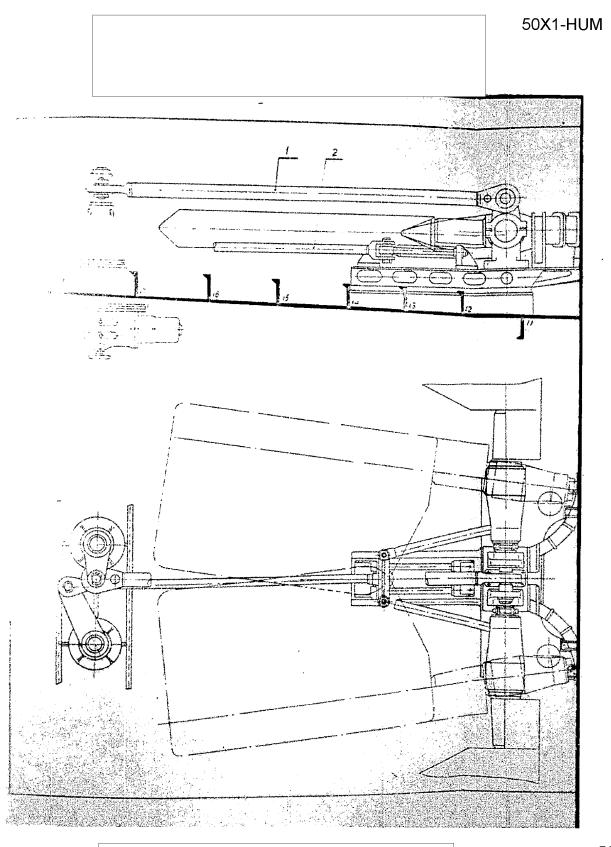
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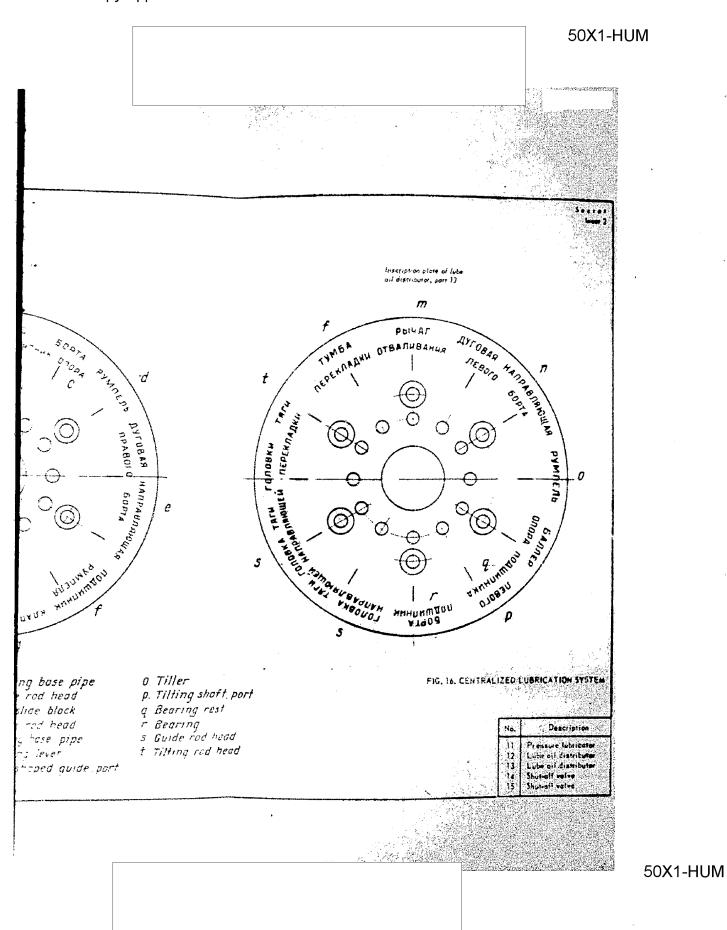


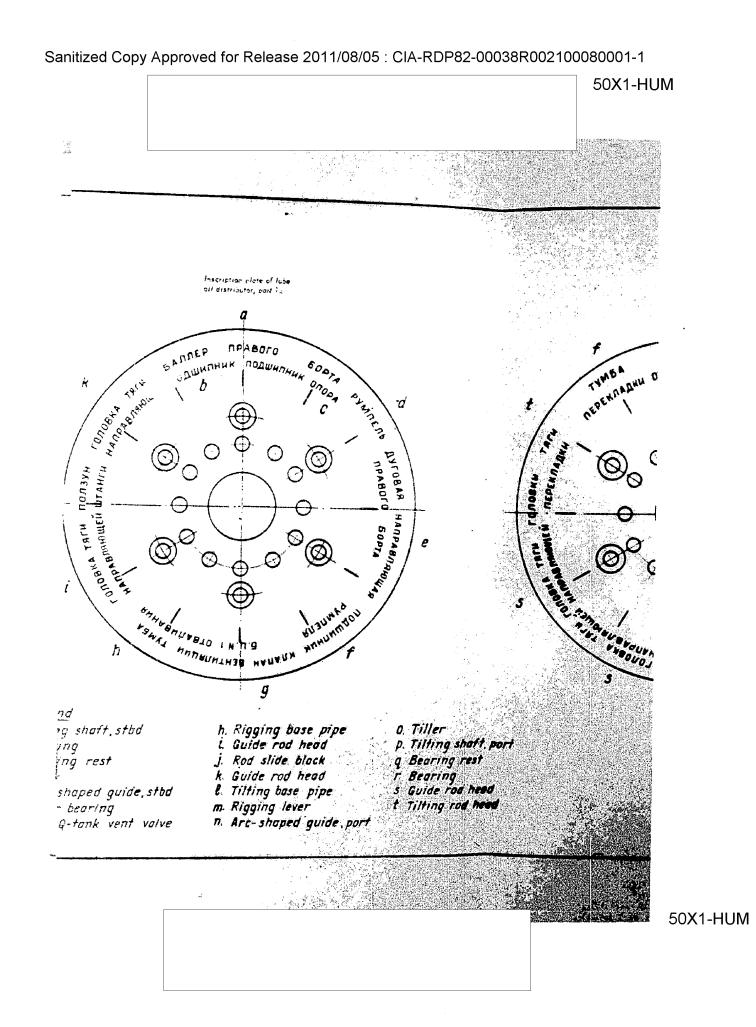


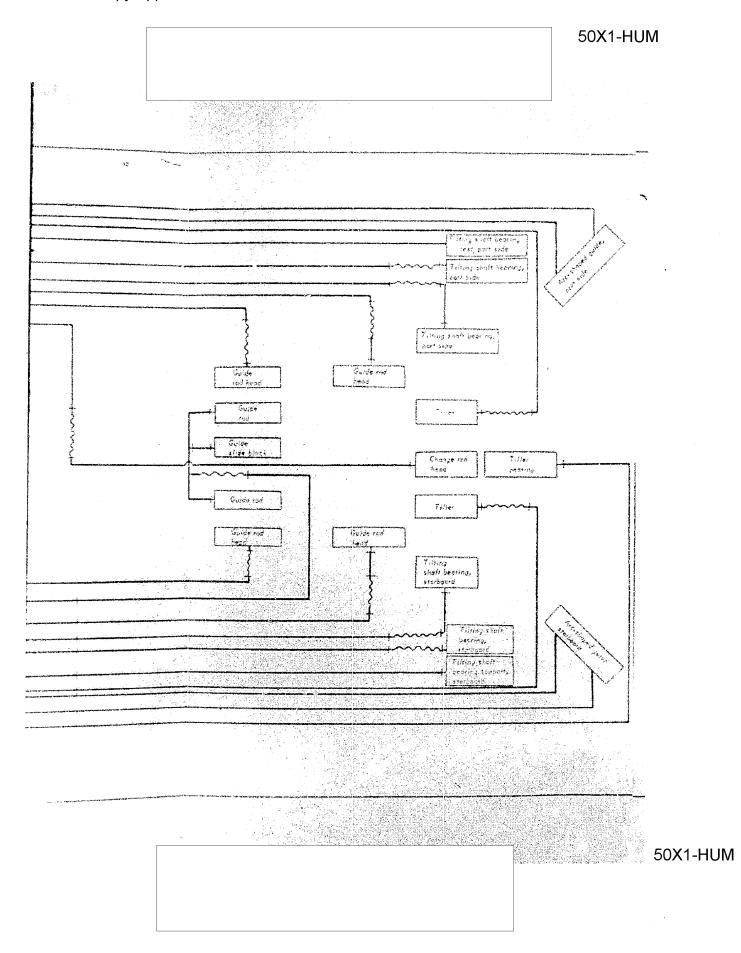


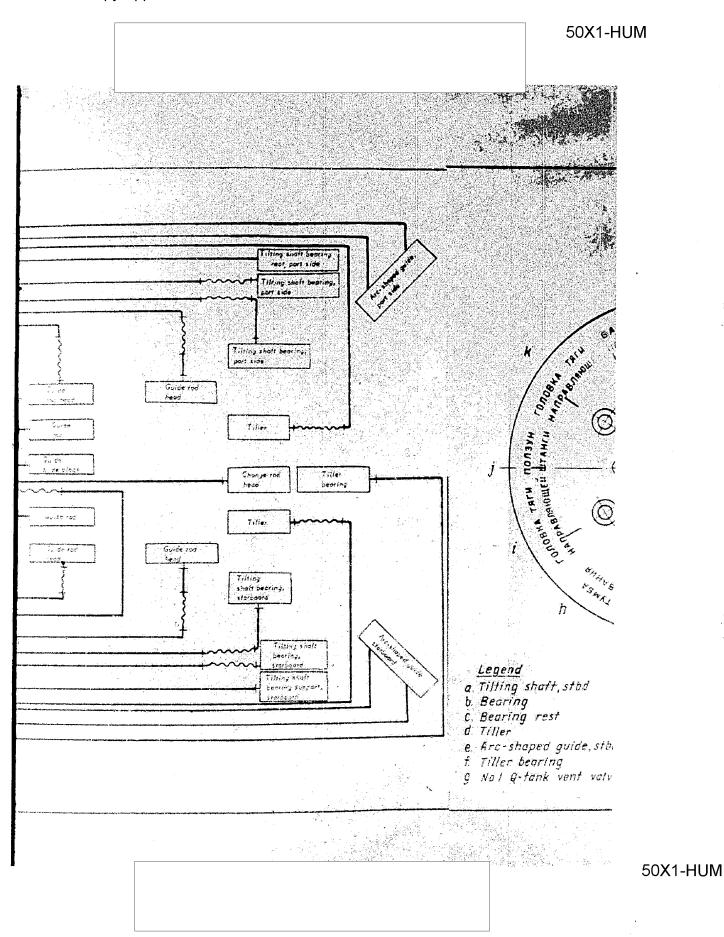


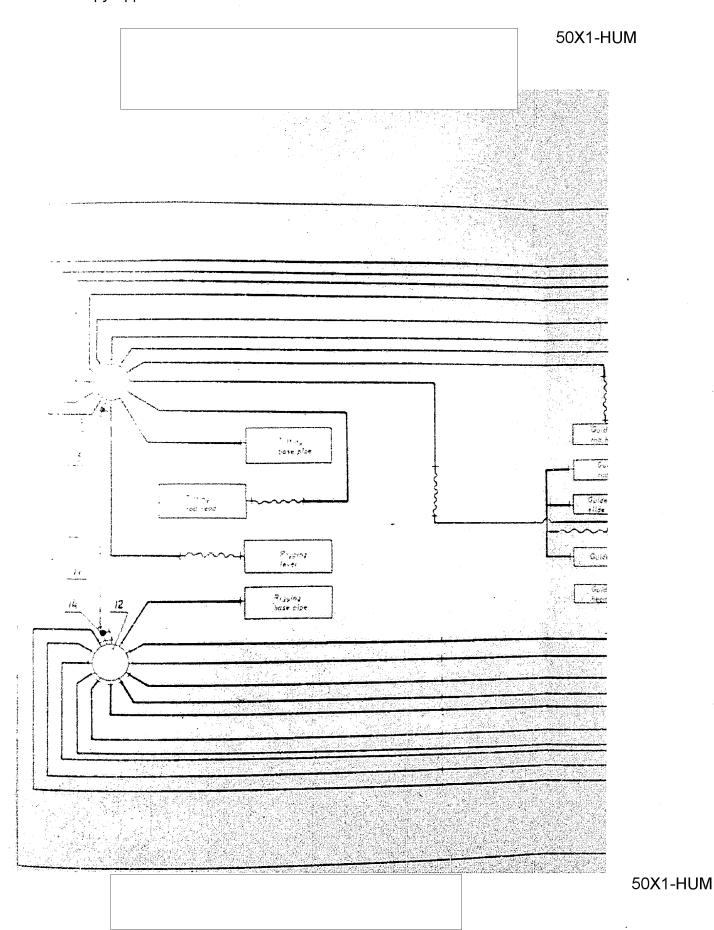


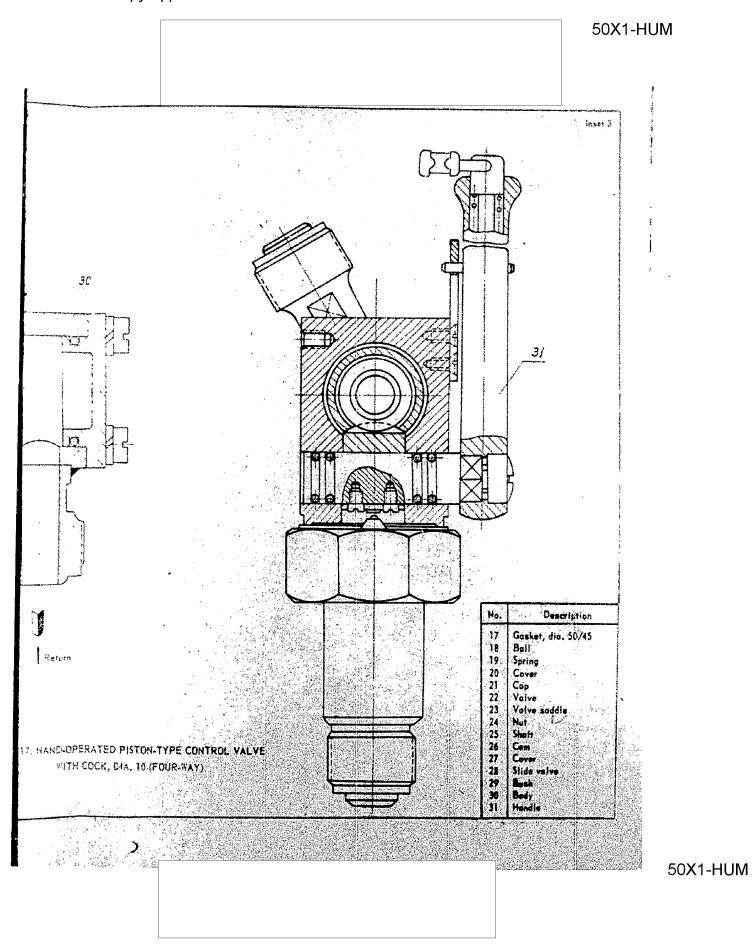


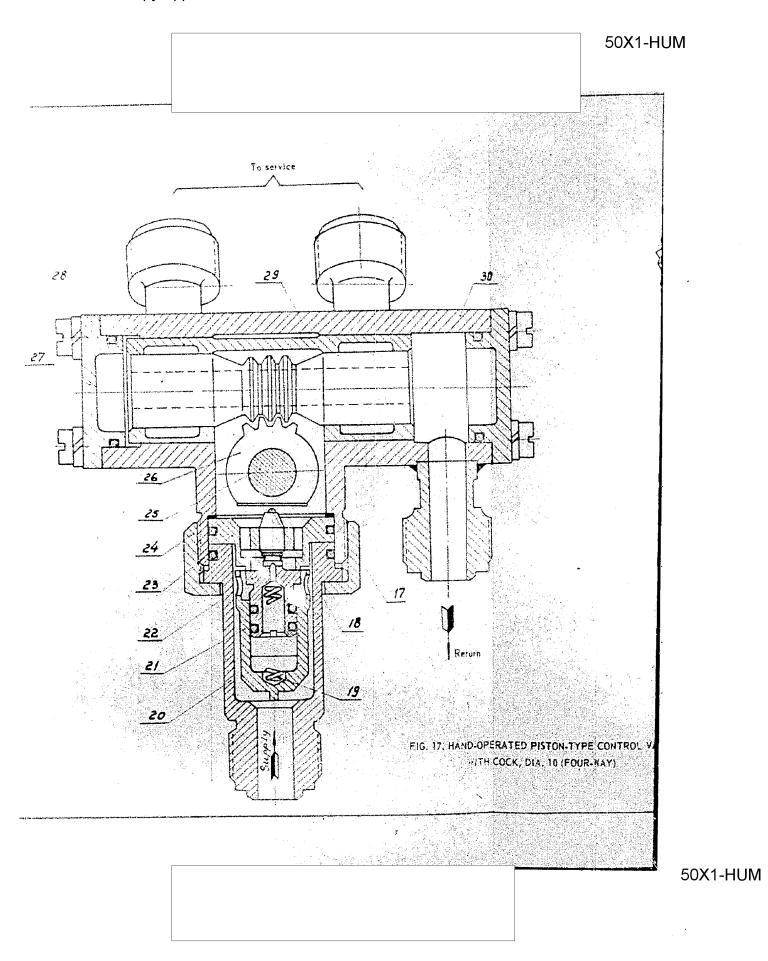




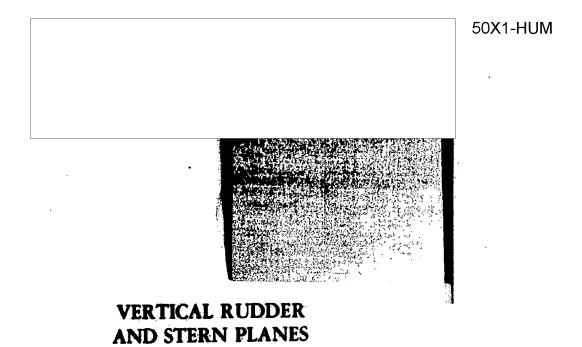












Description and Maintenance Instructions M641-A76-235

## VERTICAL RUDDER AND STERN PLANES

Description and Maintenance Instructions M641-A76-235

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The Book contains 52 pages and 4 insets between pages 50 and 51.

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CHAPTER I VERTICAL RUDDER ASSEMBLY	
	•
I. DESCRIPTION	
A. PURPOSE AND BASIC CHARACTERISTICS	
The vertical rudder is used to change the course to keep her on a preset course either when submerged surface.	of the submarine and or running on the
The basic characteristics are the following: Rudder blade area	8.06 m <sup>2</sup> ± 40°
face at a maximum speed and at a minimum pressure in the hydraulic system	20-24 sec
Diameter of the actuating ram piston	280 mm
Actuating ram piston stroke	400 mm
Maximum oil pressure	100 kgf/cm <sup>2</sup>
Type	ПН-28.5
Power	2,5 kW 1500 <b>r</b> pm
Maximum weight of steering system (to be taken into	1300 I pm
account in case of dismantling)	330 kg
Sources of power	(a) Hydraulic power; (b) Electric power (in an emergency)
B. GENERAL DESCRIPTION AND DESCRIPTION OF INDIVIDUAL UNITS	am omorganaj)
1. General Description (See Figs 1 and 21)	
The rudder is moved by hydraulic power and in an tric power.	emergency by elec-
The vertical rudder and its drive are arranged in	the aft extremity of
the superstructure and in the aft compartment of the pre-	essure hull.
The rudder blade is fitted on rudder stock l.	

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The bearings of the rudder stock serve as rudder, while the step bearing serves as the low upper cone of the rudder stock is tiller 2 conner of the drive through control rods 3 and 4.  The double-arm lever is connected with as rack of worm reduction gear 10, rod 8 and connected of the rod 6 with rod 8.  Gland 9 is provided to pack the place when the pressure hull. In case the hydraulic drive go be effected by electric drive consisting of worm gear 10 with electric motor 11. The reduction getric motor through friction clutch 12.  To put the rudder over with the aid of the trol valve with the worm reduction gear disengation when the stem of the control valve shifts, line of the hydraulic system enters the respection is drained to the return pipe line. Force from	ctuating ram 13 through the ecting rod 6.  hinged joint of connecting retained in the ecting rod 6.  the rod extends through ets inoperative, steering may a double-stage reduction ar is coupled with the electionary is coupled with the election the oil from the supply pipe we cavity of the actuating ram is trans-
mitted to the rod and to the connecting rods of the worm reduction gear. The rudder control varoom and in the conning tower with an additional bridge.  The rudder is put over by the electric driften the compartment with the aid of the electric motion from the electric motor is transmitted to the worm reduction gear and through the portion pressure hull. The worm reduction gear consistent the rudder is kept in the required position when operated by the hydraulic drive or with the reduction.	the drive through the rack of alve is sited in the control of drive (cut out) from the ve from the control room or sic control panel. In this case to the rudder stock through n of the drive outside the its of two worm gearings, n either with oil in the ram
The position of the rudder when moved by drive is shown by the electrical indicators whice electrical indicator transmitter 14, as well as be provided on the tiller and on the rod of the actual Lest the rudder should swing through an a are provided on guide rod 6 in the aft extremity. The limit switches are secured on special of the electric motor after the rudder has been in case of damage to the outboard portion the ballast tank the rudder stock is provided with swinging the rudder through an angle exceeding	th receive the pulses from by mechanical indicators 15 ating ram.  Ingle exceeding 40°, the stops  In the brackets to break the circuit turned through an angle of 20°, of the drive arranged outside the an additional stop to prevent
2. Description of Individual Units	
(a) Vertical Rudder	
This consists of blade l, stock 2 and skeg	7.

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to st	The rudder blade is of balanced type, streamlined, non-watertight ed of steel sheet with stiffeners to ensure the adequate rigidity. Welded iffeners is cast steel hub 5 to connect the blade with the cone of the through a key and cap nut 6.
The	Access to nut 6 is given through a portable plate on the blade plating. nut is locked with lock washer 9.
	In the lower portion of the blade there is steel detachable skee 7 lines
wijn braci	brass jacket and turning in step bearing 8 secured on the stern post  . Pressed into the steel cast body of the step bearing is a babbit-

lined steel support bush and a steel hardened lens.

Forged steel rudder stock 2 is arranged in two radial bearings 3 and 4 mounted in the helmport. The cast steel cages of the bearings are lined with babbit from inside.

Shifting the stock up and turning it through an angle in excess of 42-43° to any side are limited with stops secured on the rudder and with rest planks mounted on the helmport.

The radial bearings and the step bearing are lubricated remotely with the help of the lube oil distributors and the grease fitting along the pipe lines from No. VII compartment.

(b) Units of the Drive Arranged Outside the Pressure Hull (See Fig. ?!)

These are the following: tiller 2, double-arm lever 5, tiller control rods 3 and 4 and guide rod 6, guide 7 with a slide block, rod 8 and rod gland 8.

The tiller (See Fig. 3) secured on the upper cone of the stock is just a steel casting in the form of a double-arm lever with the forks at the ends; the hub of the tiller mounts the pointer of the mechanical rudder indicator.

Two rods connect the tiller with the double-arm lever (see Fig. 4) swinging on pin 2 lined with a brass jacket.

The control rods are connected with the tiller and with the double-arm lever through ball hinges which makes it possible to have a slight angular misalignement in conjugated axes.

The control rods of the tiller (see Fig. 5) are worked in steel pipes to whose ends the heads with ball inserts are welded. The guide rod is used to connect the double-arm lever with the rod of the drive and is worked in a pipe. Welded to one end of this pipe is a fork, a nut to connect to ball head 4 (see Fig. 6) of the guide being welded to the other end of the pipe. Welded to the guide rod is stop 17 to limit swinging of the vertical rudder through an angle beyond  $\pm 40^{\circ}$ .

The guide (see Fig. 6) is just cast steel casing 1 with bronze bush 2 pressed into it. Slide block 3 shifts along the bush. To keep the drive from turning, the motion of the slide block is directed by a key.

Connected with the slide block of the guide through a thread is the rod of the drive running inside the pressure hull through a gland available in the end bulkhead. The cast steel body of the gland is welded into the end bulkhead

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and is equipped with a bronze bush to receive the guide rod. The rod is packed with a soft packing (impregnated hemp).

#### (c) Actuating Ram

This (see Fig. 7) consists of a cylinder, two covers with packings and a rod with a plunger. Cast steel cylinder 1 is equipped with flanges to secure the covers, lugs being used for attachment to the seating. Each flange of the cylinder has channels for draining oil and for ventilating. The cylinder has two lugs with sockets to connect the pipe lines running from the supply and return mains.

Steel covers 2 are equipped with bronze bushes to direct the rod and packing collars. Screwed into the outer ends of the covers are nuts 5 with felt rings.

The piston of forged steel rod 4 mounts packing collars from both sides.

The rod is hollow with a socket on one end to connect the spacer of the rack of the worm reduction gear. The other end of the rod extending from the cylinder is protected with light casing 3.

### (d) Worm Two-Stage Reduction Gear

The worm two-stage reduction gear of the drive (see Fig. 22) has an automatic switch to shift to the electric drive.

Installed in cast steel body 21 through ball bearings is geared shaft 22 meshed with rack 33 of the drive.

Steel worm shaft 32 installed in the lower portion of the body through roller bearings is meshed with worm wheel 24 which is free to rotate on the geared shaft. The second end of worm shaft 32 has rigidly secured worm wheel 37 which is meshed with worm shaft 38 connected with the electric motor through a coupling.

The reduction gear body has lugs to secure to the seating and is closed with covers from the ends; cover 20 with felt packing ring and covers 23, 25 with packing collars.

Hollow cast steel rack 33 moves along brass guides. Spacers 18 are screwed into the sockets available from the ends of the rack. The spacers are locked. They are used to connect to the rod of the actuating ram and to the rod of the drive.

Screwed to the lower surface of rack 33 is toothed rack 34 meshed with spur wheel 35 fitted on the spindle of electric indicator transmitter 36.

Worm wheel 24 is kept from axial displacement with adjusting rings. Provided on one end of the wheel hub are cams to mesh with the cams of clutch 27.

Fitted on the tail of worm shaft 32 from the side of the worm is a sprocket used to connect with the sprocket of cam 31 of the emergency drive automatic connection mechanism consisting of: clutch 27 shifting on the geared shaft with a spring, bracket 30, handle 29, locking lever 28 with a spring, cam 31 with a shaft and a sprocket, a bracket with by-pass valve 26

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connected with the cavities of the hydraulic ram and with the control through the pipe lines.	
Secured on the end of geared shaft 22 is sprocket 19 connected a chain with the sprocket of the bracket of the limit switches of the motor.	through lectric
Meshed points of geared shaft 22 and rack 33 are lubricated me	musilv

Meshed points of geared shaft 22 and rack 33 are lubricated manually with consistent lubricant. Worm shaft 32 with worm wheel 24, worm wheel 37 with worm shaft 38 and the bearings of worm shaft 32 are lubricated with the oil from the reduction gear body. The roller bearings of worm shaft 38 are lubricated with consistent lubricant with the aid of the cup lubricators; the bearings and the bushes of worm wheel 24 are lubricated with consistent lubricant fed to the channel of the geared shaft with the aid of the plug.

When swinging the rudder by the hydraulic drive, handle 29 shall be pulled from the body to the extreme position so that the fork of locking lever 28 should get on the roller of the handle. Cam 31 shall be turned to the body of the drive.

With the actuating ram in operation, the geared shaft meshed with the rack is free to rotate together with the cam clutch.

When shifting to the electric power, motion from the electric motor is transmitted from the electric motor through the friction clutch to worm shaft 38 and then to worm shaft 32 which turns cam 31 through the chain drive. The cam forces the lever from the roller of the handle and clutch 27 actuated by the spring shifts until it gets meshed with the cams of worm wheel 24.

Simultaneously the piston of by-pass valve 26 will be set by the clamp to a position at which the cavities of the rams get intercommunicated and disconnected from the hydraulic pipe line due to which the piston of the ram and consequently the rack of the worm drive are free to move.

#### (e) Friction Clutch

The friction clutch (see Fig. 8) consists of steel cylindrical body I which houses two half-couplings 2 and 4. Half-coupling 2 transmits motion from the electric motor to the body through rudder flexible pins 3, to half-coupling 4 with the aid of friction rings 5. Half-coupling 4 is pressed against the body with disc 6.

In case the electric motor torque exceeds the permissible value by more than 25%, friction rings 5 will slide and such a torque will not be transmitted to the reduction gear.

### (f) Bracket with Limit Switches

Welded bracket 1 (see Fig. 9) carries two limit switches 4 and shaft 2 with two cams 3. Fitted on the shaft is sprocket 5 connected with the sprocket on the end the geared shaft of the reduction gear. Each limit switch is used to break the mains of the electric motor, after the rudder has reached an angle of 20°.

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#### (g) Control System

The control system of the vertical rudder hydraulic drive consists of the hydraulic pipe line with the shut-off and control valves one of which is sited in the control room, while the other, in the conning tower, its operating mechanism being brought out to the bridge.

The electric drive control system includes the control panel in the control room, panel switch and power supply switches. The control panel is dublicated by the similar one in the aft compartment.

The control valve is constructed as follows (see Fig. 10): steel body I houses sleeve 2, four pipe unions to connect the pipe lines. Stem 3 with raked fields communicates the cavities of the ram with the supply or return pipe line or cuts out (when in neutral) supply to the ram. The control valve is operated with the aid of handle 4.

The hollow axle of the control valve mounted in the conning tower can connect with the aid of pin 5 the shaft line of the control valve on the bridge. The axle of the control valve is locked in neutral by pin 5.

The mechanism to operate the control valve in the conning tower from the bridge consists of a bracket, a cardan shaft, a bracket of the bevel gearing and a gland.

The bracket is equipped with a control handle, a spring lock to fix the rudder in neutral and a nameplate.

The pipe lines connect the actuating ram with the hydraulic pipe line through the control and shut-off valves (see Fig. 11).

The cavities of the ram can also communicate through by-pass safety valve and through the valve of the automatic mechanism on the worm reduction gear. With the aid of the control valve the piston of the ram may be set to any position to swing the rudder through a required angle. With the stem of the control valve in neutral, the ram gets disconnected from the hydraulic system pipe line. In this case the rudder may be in any position (within ±40°).

#### (h) Auxiliary Mechanisms and Systems

These include: the by-pass safety valve (see Fig. 12) and the lubricating line of the outboard portion of the drive.

The by-pass safety piston-type valve (see Fig. 12) is intended to protect the rudder drive and the hydraulic system pipe lines from excessive loads acting on the rudder blade.

The valve consists of body 1 with sleeve 2, stem 3, discs 4, springs 5 and nuts 6. In case pressure in one of the ram cavities exceeds the permissible value, the stem moves in the sleeve thus compressing the spring; the grooves available on the stem communicate both the cavities of the ram, thus transferring oil from the cavity under increased pressure to the other.

The spring of the valve is adjusted for a pressure of 110-125 kgf/cm<sup>2</sup>.

The friction joints of the outboard portion of the drive are lubricated from the pipe lines with the aid of two pressure lubricators through two

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the oil distributors arranged on the aft bulkhead (see Fig.	
ail through the oil distributor to the points of the outboard	
The pressure lubricator consists of welded body I wit	
welded to the lower portion of the body. The sleeve is con-	name and a second and the second and
Grain pipe running to the shut-off valve of the distributor t	Parameter and the control of the con
body is a screw with piston 2 results against brass bush a	Carran 2 Al
body and simultaneously serves as the second rest for the is locked with nut 4. When the handwheel is rotated, the pis	for starts and
forward, thus forcing the lube off out.	~
The lube oil distributor (see Fig. 15) is used to distril	oute the lube oil
and to feed it to the points of the outboard portion of the dri	ve to be lubricat-
The distributor consists of cast steel body I which how	ises hollow slide
valve 2 with handwheel 4 fitted on its outer end. The body h	as shut-off valve 3
connected with the pressure lubricator through a pipe; in the	e centre of the
body there is a flange to secure the lube oil distributor to t outboard portion of the body has eight threaded sockets to r	he weld-on. The
connections of the lube oil distributes. The court of the lube oil distributes.	eceive the anion
connections of the tube of distributor. The cavity of the dis	tributor is ston-
ped with plug-nut 6, packing collar 5 being provided from the	tributor is stop-
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ped with plug-nut 6, packing collar 5 being provided from the handwheel.  3. Control Instruments  Any travel of the rudder when actuated either by the h	tributor is stop- ne side of the
ped with plug-nut 6, packing collar 5 being provided from the handwheel.  3. Control Instruments  Any travel of the rudder when actuated either by the halectric drive is indicated in the control room, conning town	tributor is stop- ne side of the  ydraulic or er, on the bridge
ped with plug-nut 6, packing collar 5 being provided from the handwheel.  3. Control Instruments  Any travel of the rudder when actuated either by the halectric drive is indicated in the control room, conning toward in the aft compartment by the electrical indicators which	tributor is stop- ne side of the  ydraulic or or, on the bridge
3. Control Instruments  Any travel of the rudder when actuated either by the helectric drive is indicated in the control room, conning toward in the aft compartment by the electrical indicators which room electrical indicator transmitter 36 sited on the worm see Fig. 22).	tributor is stop- ne side of the  ydraulic or er, on the bridge th receive pulses reduction gear
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Any travel of the rudder when actuated either by the helectric drive is indicated in the control room, conning toward in the aft compartment by the electrical indicators which rom electrical indicator transmitter 36 sited on the worm see Fig. 22).  Provision is also made for mechanical indicators mound on the rod of the actuating ram of the drive.  The pressure gauges mounted on the supply and return the hydraulic system in the control room read the pressure system.  The supply pipe line mounts the pressure gauge reading to 160 kgf/cm <sup>2</sup> with the red line indicating a working pressure of the first pipe line mounts the pressure gauge reading room 0 to 60 kgf/cm <sup>2</sup> with the red line indicating a working pressure of the first pipe line mounts the pressure gauge reading room 0 to 60 kgf/cm <sup>2</sup> with the red line indicating a working pressure of the first pipe line mounts the pressure gauge reading the first pipe line mounts the pressure gauge reading the first pipe line mounts the pressure gauge reading the first pipe line mounts the pressure gauge reading the first pipe line mounts the pressure gauge reading the first pipe line mounts the pressure gauge reading the first pipe line mounts the pressure gauge reading the first pipe line mounts the pressure gauge reading the first pipe line mounts the pressure gauge reading the first pipe line mounts the pressure gauge reading the first pipe line mounts the pressure gauge reading the first pipe line mounts the pressure gauge reading the first pipe line mounts the pressure gauge reading the first pipe line mounts the pressure gauge reading the first pipe line mounts the pressure gauge reading the first pipe line mounts the pressure gauge reading the first pipe line mounts the pipe l	ydraulic or er, on the bridge eh receive pulses reduction gear inted on the tiller in pipe lines of in the hydraulic eg pressure from gure of 100 kgf/cm.

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II. MAINTENANCE INSTRUCTIONS	
A. GENERAL SUPERVISION AND UPKEEP	4
In the course of operation see to it that the steering gear be in gooder and in constant readiness for action, for which purpose do the following:  1. Ferform an external inspection to make sure the arrangement whole is in good order.  2. See to it that no oil leaks through the packing of the actuating rod.  3. Make sure that adequate amount of lube oil is provided in the transpoints.  4. Put the rudder over and check to see that the mechanical and trical indications are identical.  5. Perform preventive maintenance and repairs proceeding in actions with the directions outlined under Section II, E.  6. When diving, check to see that water does not leak through the packings, tighten up and repack the gland packings if necessary.	as a ram fric- elec- ecor- e gland
7. Care should be taken that no foreign matter is allowed to be put the proximity of the movable parts.  8. Check the arrangement for proper attachment to the seating.  9. Ensure that no air is present in the hydraulic ram.  10. Keep the nameplates in good order.	resent
B. PREPARATORY TO OPERATION  11. See to it that the party of the appropriate had in the initial a	
II. See to it that the parts of the arrangement be in the initial $p_{\rm C}$	$S_{i} \in \mathcal{D}_{\bullet}$
Initial Position	
<ul> <li>(a) The rudder is in neutral (in the CL).</li> <li>(b) The handles of hydraulic control valves 4 and 7 (see Fig. 11) in mid-position and locked with pins.</li> <li>(c) Valves 1, 3, 5 and 6 (see Fig. 11) are shut.</li> <li>The valves between the grease fittings and the lube oil distribute shut.</li> </ul>	
(d) Cam clutch 27 of the worm reduction gear is disengaged (the pass valve is shut), lever 28 lies on the cylindrical portion of the cam (see Fig. 22).  (e) The handle of the bracket on the bridge is locked with a pin.  (f) The mechanical and electrical indicators read zero.  (g) The switch of the control panel of the emergency electric driven zero position.	clutch
(h) The switch to supply power to the electric motor is at zero.  (i) The control panels of the emergency electric drive are in neu-	ıtral.
Preparation for Starting	
Check the drive to make sure that it is in good order.	E E

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12. When putting the rudder over with the aid of the h from the control room, do the following:  (a) check the pressure of the working oil in the hydra read off the pressure gauge (which shall in the hydra	
(b) remove the pin locking the handle of the control v	0 kgf/cm²); alve in the control
(c) open shut-off valves I and 6 (see Fig. II) on the supply pipe lines of the hydraulic system.  13. When putting the rudder over with the aid of the hydraulic system.	
(a) perform the procedures outlined under them that	of Dame 12.
(b) remove the pin locking the handle of the control viower; (c) open shut-off valves 1, 3 and 5 (see Fig. 11) on the	
14. When putting the rudder over with the aid of the h from the bridge:	ydraulic drive
<ul> <li>(a) perform the procedures outlined under Item "a"</li> <li>(b) remove the pin locking the handle of the control viower and use the same pin to connect the shaft linkage with (c) open shut-off valves 1, 3 and 5 (see Fig. 11) on the pipe lines of the hydraulic system;</li> <li>(d) remove the pin from the handle of the bracket on 15. When putting the rudder over with the aid of the example of the same procedures.</li> </ul>	valve in the conning th the control valve; supply and return the bridge.
drive:  (a) set the switch of the control panels to the CONTR	
Note: To operate the electric motor from the aft concontrol panel switch to the CONTROL FROM T MENT;	
(b) turn on the switch to supply power to the electric	motor.
C. STARTING, DURING-OPERATION MAINTENANCE AND STOPPING	Ε
Starting	
ontrol room and from the conning tower, proceed in the formulation to the part of the respective control valve to the rudder to the port side and to the right, to put the rudder to side. Watch the position of the rudder by the electrical indicated has been put through a preset angle, smoothly set if control valve to mid-position.  17. To put the rudder with the help of the hydraulic draining, turn the handle of the bracket on the bridge to the latter rudder to the port side and to the right when putting the	ollowing manner.  left to put the the starboard icator. After the he handle of the live from the eft, when putting
	5

the rudder tion by har	Watch the position of the rudder by the electrical indicator. I has reached a preset angle, smoothly set the handle to mid-pad. Then putting the rudder by the emergency electric drive, do the	-i 80
following: (a) to of the redu the electri on the elec deflect; (b) so right or to	arn the handle of the control panel to any side to engage the chaction gear. Make sure that the clutch gets engaged as shown a cal indicator or an ammeter; when the clutch is engaged the learning motor increases which makes the pointer of the ammeter wing the rudder by turning the handle of the control panel to the left for putting the rudder to starboard or to the port side ly. Watch the electrical indicator to check the rudder position	utch by ad
After the r	rudder has been put through a required angle, set the handle to	zei
	FION: 1. Do not swing the rudder with the aid of the emergency ive in the following cases:	y
	(a) with the wing shaftings in operation when the sub- running at a speed exceeding 10 knots through angles beyond \$15°;	is
	<ul> <li>(b) with the centre shafting when the sub is running at speed exceeding 3 knots through angles beoynd ±20° at a speed exceeding 5 knots through angles beoynd ±</li> <li>2. Do not put the rudder over with the aid of the hydraul drive when the sub is backing at a speed of up to 10 k through angles of up to ±15°. NEVER use the electrical drive when the sub is backing.</li> <li>3. Do not put the rudder over with the hydraulic drive the</li> </ul>	and 6". ic nots
	an angle beyond \$\pm440^\circ\$.	
occur.	above requirements are not followed, damage to the drive ma	•
Note:	Difference in readings of the electrical and mechanical indictions is within \$\frac{1}{2}.50\cdot\$.	a-
Dur	ing-Operation Maintenance	
order; give control valve 20. Lu 21. If the brackets motion of the submari 22. When the paner of the control paner of the submari 22.	e to it that the rudder drive and the control system are in good attention to the packings of the drive rod, the actuating ram rees, by pass safety valve and the valve on the reduction gear. The structure all the friction joints of the drive in due time. When turning the handles of the control valves or the handles of son the bridge, the electrical indicator shows no motion or show rudder, shift to the emergency electrical drive; the speed of the in this case shall be reduced (see the above caution, item in this case shall be reduced (see the above caution, item in the putting the rudder over, watch the pressure gauge of the electrical drive; which keeps on dropping, the red warning lamp will	od, ow f
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light up on the hydraulic system alarm board in the control room. In the case, immediately shift to the electric drive.	
23. If with the emergency electric drive in operation, the electric power supply circuit of one side gets open, (the pointer of the ammeter at zero) immediately shift to the power supply from the	motor Stops

Stopping

24. When the rudder is moved by hydraulic power, proceed as follows: bring the hydraulic drive of the rudder to the initial position following the directions outlined under Subsection "B".

When putting the rudder with the emergency electric drive:

at zero) immediately shift to the power supply from the other side.

- (a) from the control station bring the rudder to neutral position proceeding in accordance with the directions outlined under Subsection "B";
- (b) set the switch of the control panel to CONTROL FROM THE AFT COMPARTMENT:
- (c) disengage the cam clutch, pulling the handle of the automatic change mechanism simultaneously starting the electric motor to the side opposite to the previous direction of rotation. In this case the lever shall get on the roller of the handle.

Set the control panel in the aft compartment to neutral;

- (d) set the electric motor power supply switch to neutral;
- (e) set the control panel switch to zero position.

Note: After the electric drive has been put out of operation, shift for putting the rudder over with the aid of the hydraulic drive.

#### D. TROUBLES AND REMEDIES

25. Given below are troubles which are likely to occur and corrective measures to be taken to eliminate these troubles.

No.	Symptom or difficulty	Condition may be due to	Correction
1	Misalignement of rudder indicators		Disengage toothed wheel from rack secured on worm reduction gear and by turning shaft of transmitter align electrical indicators with test mechanical indicators. In this position engage toothed wheel with rack on
2	rudder shifts by it- self from preset	(a) Defective packing in actuating ram piston (b) Oil flows in by- pass valves on worm	worm reduction gear (a) Replace defective collars in ram piston (b) Adjust valves at base, if the sub is at

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N	o Symptom or difficulty	Condition may be due to	Correction
		reduction gear or in bypass safety valve	sea, shift to emergency electric drive
3	Oil leaks from ram, by-pass valve on worm reduction gear, control valves and worm reduction gear	Packings defective	Replace defective pack- ing collars of actuating ram piston rod, worm reduction gear or pack- ing rings of valves and control valves
4	•	Packing loose or defective	Tighten up respective gland or replace pack- ing
5	not put the rudder over	Spring slack or da- maged, therefore cam clutch of worm reduction gear not engaged	Replace spring of cam clutch of worm reduc- tion gear
6	effected with elec- tric drive, rudders are put over by	Slack or damaged springs of friction clutch of emergency electric drive. Clutch slides	Replace springs of friction clutch and adju- clutch for preset torque

#### E. PREVENTIVE MAINTENANCE AND REPAIRS

Daily Inspection

- 26. Perform an external inspection of the main units of the gear arranged outside the pressure hull and make sure that they are in good order and no foreign matter is present on the way of the movable parts.
- 27. When the sub is at anchor check the steering system for operation by putting the rudder over with the aid of the hydraulic and electrical drives for two times, and simultaneously check the mechanical and electrical indicators for indentical readings, a difference within \$\ddot 2.500\$ being permissible.

Weekly Inspection

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Perform the procedures of daily inspection and in addition, do the following:

- 28. Inspect and clean the units of the steering system arranged outside the pressure hull above the waterline.
- 29. Lubricate the units of the steering gear from the centralized lube oil system.
- 30. Lubricate by hand the toothed rack of the worm reduction gear, the toothed wheel of the transmitter of the electrical indicator and the axles of the control valve handles.

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32. The system and i valves.	ricate the bushes of the worm wheel of the bearing, the plug on the end of the geared shaft of the reduc roughly inspect all the joints and the fittings of the mecessary, tighten up the joints and the gland packi	tion gear. hydraulic ings of the
tion gear. It is 34. Lub conning towe	ch the gauge glass to check the level of oil in the wnecessary, replenish the reduction gear with oil. ricate the bevel gearing in the superstructure, the r, the bracket on the bridge by pressing the cup lub (II them with fresh lube oil when necessary.	gland in the
-	In case of protracted submerged running (endural included), the units mentioned in Item 34 shall be inspected and thickly lubricated.  When lubricating the friction surfaces of the outb of the drive, the valves between the grease fitting oil distributors shall be open. For the rest of the shut.	thoroughly  coard portion  g and the lube
Mont	hly Inspection	
following:	m the procedures of the weekly inspection and in a ck the glands of the actuating ram rod for leaks in	
Year	1 y	
a whole giving fastenings, a 37. Chawell as in the and channels 38. Che tion gear for	eck the ball bearings and the roller bearings of the condition. The clutch and coat the bush with lube oil and protections.	eaded joints, wer sail, as the oil holes be worm reduc-
	ng-Docking Inspection	
rudder indic 40. Ch	eck and align position of the vertical rudder with tators.  eck the securing of the vertical rudder and condition well as check the units, bolted joints and locking	on of the swing-
Thorog	assemble the outboard portion of the vertical rude ighly inspect the corroded or defective parts to ma for further operation.	ier arrangement. ake sure they
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NEVER	ise corroded threaded parts, bolts, nuts and lock washers.	47.
thoroughly clear pins shall be r	sion from the surfaces which are not in use, after which an, ground and paint them. All the lock washers and cotter eplaced. See to it that the fastenings have protective coating not the Data Book to indicate replacement of the parts and	g:
fastenings. 42. Check	k the condition of the protectors in the proximity of the ver	ti-
cal rudder gea	r arrangement. Clean or replace the protectors.	••
43. Repla	ce the gland packings in the stuffing tubes leading to the pre-	es.
44. Meas	ure the clearances in the friction units arranged outside the If the clearances exceed the permissible values, repair the	
45. Check centralized lub	to see that lube oil flows to the friction parts from the see oil system which will be indicated by the lube oil passing arances of the surfaces lubricated.	š
Durin	g-Running Repair Inspection	
which were not	letely disassemble the sections of the vertical rudder driv repaired when docking the submarine; replace the worn rubber collars, rings of the collars and paronite gaskets.	e,
CAUTION	I! Never install the rubber collars and rings which have scores, notches and other defects; never eliminate these troubles by filing the parts; under no circumstances in- stall unspecified rubber packing rings and at no time u cutting tools for driving the rubber packings into their s	se
F, DISAS	SEMBLY AND REASSEMBLY	
(in the sc	ope of preventive maintenance and repairs)	
Gener	a l	
47. Mark of the shims.	the conjugated parts, giving special attention to the marki	ng
48. Care	should be exercised to protect from damage the friction. sets to be disassembled.	ur-
Disas	sembly	N.
drain plugs and	oil from the cylinders of the actuating ram by opening the the vent plugs.	
50. Drain	t the pipe line and blank off these openings in the ram. oil from the worm reduction gear.	
51. Discon	meet the actuating ram and the rod of the drive from the and remove the actuating ram and the reduction gear from	

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	52. Remove the control rods of the tiller and turn out the guide rod	f
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from	53. Shift the rod of the drive sternward, unscrew the guide slide block it.	
	54. Remove the gland packing, pull the rod of the drive to the compart-	
ment.		•
the a	55. Further disassembly of the units accomplish in accordance with companying drawings.	
	56. Inspections, repairs and replacements of the parts should be noted	ı
in the	Data Book.	
	Reassembly	
pende remo	57. For reassembly of the units of the rudder drive proceed in the reverse to that of disassembly in accordance with the drawings aped to the Instructions. Prior to reassembly wash the parts in kerosene we old lubricant, wipe them dry and coat them with a thin layer of free land.	to sh

- 58. After reassembly charge the actuating ram with oil and check it for tightness under a pressure of 100 kgf/cm<sup>2</sup>. When charging the ram with oil, bleed air from it through the needle plugs.
- 59. Check the rod of the drive and the shaft linkage for proper packing; checking shall be timed to checking the pressure hull of the sub for vacuum.
- 60. Adjust the pressure-reducing valve seated on the hydraulic system pipe line (See Basic Characteristics) to ensure the required time for putting the rudder over.
- 61. After reassembly bring the drive to the initial position, proceeding—in accordance with the instructions outlined under Section II-B.
- 62. Check the arrangement as a whole proceding in accordance with the directions stated in Section II-C.

#### G. REFERENCE DATA

- 63. The service life of the rubber packing rings and the collars is equal to 5 years, the term of storage being included, after which the collars and the rings in the ram and in the control valve shall be replaced.
- 64. The working medium employed in the hydraulic system is spindle oil, mark AV.
- 65. The friction surfaces outside the pressure hull are lubricated with AMC-3 lubricant, while those inside the pressure hull with gun grease.

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Chapter II	
STERN PLANES ARRANGEMENT	
1. DESCRIPTION	
A, PURPOSE AND BASIC CHARACTERISTICS	
The stern planes (together with the bow planes) are of the submarine in the vertical plane, to keep her at a prese to prevent her from broaching during firing the torpedoes range of her speeds.	t depth, as well as
Basic Characteristics	
Total area of the blades	
Tilting ram piston diameter	220 mm
Tilting ram piston travel	400 mm
Maximum pressure of oil	100 kgf/cm <sup>2</sup>
Type	ПН <b>5-</b> 45
Power	2.2 kW
Speed	1450 rpm
taken into account in case of dismantling	330 kg
Planes control:	•
	(b) Eme <b>rgency,</b> electrical
B. GENERAL DESCRIPTION AND DESCRIPTION OF INDIVIDUAL UNITS	
1. General Description (See Figs. 16 and 23)	
The stern planes are tilted for diving and surfacing we hydraulic drive and in an emergency with the emergency element of the stern planes and their drive are arranged in the steeperstructure and in the aft compartment of the pressure that the blades of the planes are arranged from each side	ectric drive.  If extremity of the state of
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common tilting shaft 39 installed in the support bushes of stern tube 40 of the aft extremity. Detachable tiller 41 secured on the tilting shaft is connected with tilting ram 47 through the rack of worm reduction gear 46, rod 44 and control rod 42.

The direction of rotation of the hinged joint of control rod 42 is ensured by guide 43.

Gland 45 is installed in the place where the rod passes through the pressure hull.

Provision is made for the emergency electric drive in case the hydraulic drive gets defective. The electric drive consists of two-stage worm reduction gear 46 with electric motor 48. The reduction gear is connected with the electric motor through friction clutch 49.

Tilting the planes hydraulically is effected with a control valve.

In this case oil from the supply pipe line of the hydraulic system enters the respective cavity of the tilting ram and is drained from the other cavity to the return pipe line.

The force from the tilting ram is transmitted to the rod and to the control rod of the drive through the rack of the worm reduction gear. The control valve to operate the planes is sited in the control room. The planes are tilted with the aid of the emergency electric drive from the control room or from compartment VII with the aid of the electrical control panel.

Motion from the electric motor to the tilting shaft of the planes is transmitted through the worm reduction gear and through the portion of the drive arranged outside the pressure hull.

When tilted by the hydraulic drive the planes are kept in the required position with the oil in the tilting ram, when tilted with the aid of the vectric drive the planes are kept in the required position by the non-overhauling gearing of the reduction.

Any change in position of the planes when tilted either by the hydraulic or electric drive is indicated by the electrical indicators which receive the pulses from transmitter 51 of the electrical indicator and by mechanical tilt indicator 50 placed on the rod of the tilting ram.

So that the planes should not be tilted through an angle exceeding  $30^{\circ}$ , stops are provided in the aft extremity.

#### 2. Description of Individual Units

#### (a) Stern Planes

These are composed of two blades I with welded-in hubs 3 and tilting shaft 2 which interconnects them (see Fig. 17).

The blade of the stern planes differs from that of the vertical rudder in size.

Forged steel tilting shaft 2 rests in two support bronze bushes of the stern tubes in the aft extremity. The tilting shaft is kept from axial displacement with the support adjusting rings arranged between the ends of hubs 3 of the blades and the support bushes of the stern tubes. The support bushes are lubricated from the pipe line running from the aft compartment through the lube oil distributor with the aid of the grease fitting.

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#### (b) Units of the Drive Outside the Pressure Hull

These are the following (see Fig. 23): tiller 41, control rod 42, guide with slide block 43, rod 44 and gland 45 of the rod.

The tiller (see Fig. 18) is of split-type. This is secured in the centre of the tilting shaft. The parts of the hub viz. body 2 and cover 4 are coupled with bolts 3. The end of the lever opposite to the hub has forks with pin 1 to connect with the ball head of the tiller control rod (see Fig. 19).

The control rod of the tiller is worked in a steel pipe. The ball insert and the nut are welded to the ends of this pipe. The nut is used to connect with ball head 4 of the guide (see Fig. 6).

The guide, the control rod of the drive and the gland are similar in their construction to those of the vertical rudder drive.

The movable parts of the drive are lubricated similarly to those of the vertical rudder drive.

#### (c) Tilting Ram

The hydraulic ram of the drive of the stern planes differs from that of the vertical rudder in size only (see Fig. 7).

#### (d) Two-Stage Worm Reduction Gear

The worm reduction gear of the stern planes drive (see Fig. 24) slight differs from that of the vertical rudder arrangement, i.e. in the construction sizes and in the size of the toothed wheel of the transmitter drive.

# (e) Friction Clutch and Bracket with Limit Switches

The friction flexible clutch of the drive does not differ from that of the vertical rudder except for the internal diameter of the hub for the electric motor shaft.

The bracket with limit switches is also similar to the respective mechanism of vertical rudder drive.

#### (f) Control System

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The control system of the stern planes arrangement consists of the hydraulic pipe lines with the shut-off valves and the control valve placed in the control room. The construction of the control valve is identical to that of the vertical rudder drive (see Fig. 10).

The control system consists of the electrical control station sited in a control room dublicated by the electrical control station sited in the aft compartment.

The tilting ram is connected through the pipe lines with the shiphers hydraulic system through the control valve.

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The cavifies of the ram are interconnected through the by-pass safety valve and through the by-pass valve of the automatic mechanism on the worm reduction gear.  The piston of the tilting ram may be set to any position with the help of the control valve to tilt the planes through a required angle within 230°.	·
3. Auxiliary Mechanisms and Systems	
These are the following: the by-pass safety valve and the lube oil pipe line for the outboard parts of the drive.  The safety by-pass valve is of a piston-type used to prevent the tilting	

ram and the pipe lines from excessive pressure. This is similar to that of the vertical rudder drive (see Fig. 12).

The friction joints of the outboard portion of the drive are lubricated in the way similar to the vertical rudder drive.

#### 4. Control Instruments

Any travel of the planes when tilted either with the hydraulic or electric drive is indicated in the control room and in the aft compartments by the electrical tilt indicators which receive the pulses from the electrical indicator transmitter mounted on the worm reduction gear.

Provision is also made for a mechanical tilt indicator on the control rod of the tilting ram of the drive.

The pressure gauges installed on the supply and return pipe lines of the hydraulic system in the control room are used to read the pressure in the hydraulic system.

For description of the pressure gauges see the respective section of the vertical rudder description.

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71 34 A I	NTENANCE INSTRUCTIONS	
		1
A. GEN	ERAL SUPERVISION AND UPKEEP  course of operation see to it that the steering gear be in g	good
In the corder and in	complete readiness for action, for which purpose do the	fol-
	orm an external inspection to make sure that the arrange	
	a decident	
		a. ne fric-
	hat no oil leaks through the packing as sure that an adequate amount of lube oil is present in the	-
tion points.	the planes to make sure that the electrical and mechanic	al in-
	the same readings.	
5 Dorf	orm preventive maintenance and preventive repairs pro-	eeding
6. Wher	diving make sure that no water leaks through the gland k to see that no foreign matter be present in the proxim	ity of the
7. Chec	s of the arrangement.	•
8 Chec	k the units for proper attachment to their scattings.	
9. Make	sure that no air is present in the hydraulic ram.	
10. Keep	the nameplates in good order.	•
B. PRE	PARATORY STEPS	
ll. See t	o it that all the parts be in the initial position.	
Initi (see Fig	al position (. 20)	
(a) The	planes in neutral.	
	aulic control valve handle 2 in neutral and locked with	₹ pin.
	es 1 and 3 shut.	hu-necs
	cam clutch of the worm reduction gear disengaged (the ne lever lies on the cylindrical portion of the cam clute	
	mechanical and electrical indicators read zero.	
	switch of the emergency electric drive control panel in	zero.
• • •	r supply switch of the electric motor at zero.	
(h) The	emergency electric drive control panels in zer-	
Prepa	ratory to Operation	ම . නවා.
	e drive and make sure it is in working order.	
	tilting the planes by hydraulic power:	<b>:-</b>
	t the pressure of the working oil in the hydraulic systemall be within 77 to 100 kgf/cm² as read off the pressure.	
	ve the pin locking the handle of the control valve;	B9
	the shut-off valves on the supply and return pipe lines	of the
nyaraulic syst		
•		
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		5

13. When thring the planes with the emergency electric drive;
(a) set the switch of the control panel to the CONTROL FROM THE CONTROL ROOM position.

Note: In case the electric drive is to be operated from the aft compartment, set the switch to CONTROL FROM THE AFT COMPARTMENT position.

- (b) turn on the electric motor power supply switch.
- C. STARTING, DURING-OPERATION MAINTENANCE AND STOPPING

Starting

14. When tilting the planes with the aid of the hydraulic drive, proceed as follows:

Turn the handle of control valve 2 (see Fig. 20) down or up for diving and surfacing respectively. Watch the electrical indicator to check the position of the planes. After the planes reached a required angle, smoothly set the handle of the control valve to neutral by hand.

- 15. When tilting the planes with the aid of the emergency electric drive, proceed as follows:
- (a) turn the handle of the control panel to any side to engage the clutch of the worm reduction gear. Make sure that the clutch of the reduction gear gets engaged which shall be indicated by the electrical tilt indicator or the animater (when the clutch is engaged, the load on the electric motor increases, thus causing the pointer of the ammeter to deflect);
- (b) tilt the planes by turning the handle of the control panel for diving or surfacing. Watch the electrical indicator to check the position of the planes. After the planes have been tilted through a required angle, set the handle of the control panel to neutral.
  - WARNING, 1. The emergency electric drive shall not be used in the following cases:
    - (a) with the centre shafting in operation when the submarine is running at a speed of above 10 knots through angles beyond ±15°;
    - (b) with two wing shaftings or one wing shafting when the sub is running at a speed more than 8 knots through angles beyond  $\pm 8^{\circ}$  and when the sub is running at a speed of more than 6 knots through angles beyond  $\pm 15^{\circ}$ .
    - 2. The planes shall not be tilted through angles beyond \$30° with the aid of the hydraulic drive.

The above requirements shall be strictly observed otherwise damage to the planes may occur.

Note: Difference in readings of the mechanical and electrical tilt indicators should not exceed \$2.50.

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During-Operation Maintenance  16. See to it that the drive of the planes and the control systematic good order. Give special attention to packing of the drive rod, the good order. The control valve, the by-pass valve on the	em be in control
good order. Give special attention to packing of the distance of the tilting ram, the control valve, the by-pass valve on the duction gear and the by-pass safety valve.	

- 17. Lubricate all the friction parts of the joints of the drive in
- 18. If when turning the handle of the control valve, the electrical indicator will show no motion or too slow motion of the planes, immediately shift  $\mathfrak{t}_{\mathbb{C}}$ the emergency electric drive; reduce the speed of the submarine in this case (See the Warning, Item 1).
- 19. When tilting the planes watch the pressure gauge of the control pane to check the pressure of oil in the hydraulic system. Under a pressure of 70 kgf/cm<sup>2</sup> which keeps on dropping, the red warning lamp will light up on the hydraulic system alarm board in the control room.

In this case immediately shift to operation with the electric drive.

20. If when the emergency electric drive is used, the electric motor power supply circuit of one side gets broken (the pointer of the ammeter get in zero), change over to the power supply of the opposite side.

#### Stopping

- 21. When tilting the planes with the hydraulic drive, bring the hydraulic drive of the planes to the initial position proceeding in accordance with the directions outlined under Subsection "B".
  - 22. When tilting the planes with the emergency electric drive:
- (a) with the aid of the control panel bring the planes to neutral proceeds. in accordance with the instructions under Subsection "B";
- (b) set the switch of the control panels to the CONTROL FROM All I COMPARTMENT position;
- (c) disengage the cam clutch by pulling out the handle of the automatic change mechanism simultaneously starting the electric motor to run in the direction opposite to the previous. The lever shall get on the roller of the handle. Set the control panel in the aft compartment to neutral;
  - (d) the electric motor power supply switch shall be set to zero. Set the switch of the control panels to zero.

After the electric drive has been put out of operation, shift to the hydralic drive.

#### D. TROUBLES AND REMEDIES

23. Given below are troubles which are likely to occur in the course of operation and the corrective measures to be taken to eliminate them.

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No.	Symptom	Condition may be due to	Correction
1	Misalignement of tilt indicators	•	Disengage the toothed wheel from the rack secured on the worm reduction gear and by turning the shaft of the transmitter align the electrical indicators with the test mechanical indicator. In this position engage the toothed wheel of the transmitter with the rack on the worm reduction gear
2	Planes tilted too slow or spontaneously shift from preset angle of tilt	(a) Defective packing in tilting ram piston  (b) Gil leaks in by-pass valve on worm reduction gear or by-pass safety valve	(a) Replace defective collars of tilting ram piston  (b) Adjust valve at base in case sub is at sea, change over to emergency electric drive
3	Oil leaks from tilt- ing ram, by-pass valve on worm reduc- tion gear, control valve and worm re- duction gear	Packing defective	Replace defective col- lars of tilting ram con- trol rod, worm reduc- tion gear or packing rings of valve and con- trol valve
4	Defective packing in gland of control rod of drive	Untight or defective packing	Tighten up gland or replace packing
5	Cam clutch will not engage which re- sults in idle running of electric motor	Slack or damaged spring	Replace spring of cam clutch of worm reduc- tion gear
6	Friction clutch of emergency electric drive slips frequently	Slack or damaged spring	Replace spring of fric- tion clutch and adjust clutch for preset torque

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# E. PREVENTIVE MAINTENANCE AND REPAIRS

# Daily Inspection

24. This is similar to that of the vertical rudder arrangement (see page 40, Items 26 and 27).

## Weekly Inspection

25. This is similar to that of the vertical rudder arrangement (see page 41, with the exception of Items 28 and 34).

### Monthly Inspection

26. This is similar to that of the vertical rudder arrangement (see page 42).

#### Yearly

- 27. Perform an external inspection of all the mechanisms of the drive.
- 28. Change lube oil in pressure and cup lubricators and clean all the lube oil holes and channels.
  - 29. Check the roller and ball bearings of the worm reduction gear.
- 30. Open the clutch and lubricate the bush, keeping the lubricant is om getting on the friction discs.

### During-Docking Inspection

- 31. Check and align the position of the stern planes with the nice lanca. tilt indicator.
- 32. Check the attachment of the stern planes and condition of the tilting stops as well as as the units, bolted joints and locking parts.
  - 33. Disassemble the outboard portion of the arrangement.

Thoroughly inspect the corroded and defective parts to assure whether they are serviceable or not.

NEVER use corroded threaded parts, bolts, nuts and lock washers.

Remove corrosion from the surfaces which are not in use, clean them, ground and point afterwards.

Replace all the lock washers and cotter pins.

See to it that the fastenings have protective coating.

Entries on replacement of the parts and fastenings shall be made in the Data Book.

34. Check the protectors in the area of the stern planes arrangement. Clean or replace the protectors.

NEVER paint the protectors.

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- 35. Replace the packing in the stuffing tube leading to the pressure hull independently of its wear.
- 36. Measure the clearances in the friction units pairs arranged outside the pressure hull. Perform repair if the clearances are out of specified values.

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	e sure that the friction surfaces are lubrication system which will be indicated learances of the surfaces lubricated.	icated from the by the lube oil
	ng Running Repair Inspec	t i o n
sub was dockenite gaskets,	depletely disassemble, inspect and repair tern planes arrangement which were not ed; replace wern parts, rubber collars, r NG: Do not install rubber collars and ring thes and other defects; do not eliming the parts; never install unspecified in and under no circumstances use cutte the packings into their seats.	repaired when the rings, cups and paro- gs with scores, not- nate them by filing
F. DISA	SSEMBLY AND REASSEMBLY	
(in the s	cope of preventive maintenance and repa	airs)
	ssembly and reassembly of the stern placetical rudder arrangement.	anes are similar to
G. REF	ERENCE DATA	
40. The ment.	se are similar to those given for the ver	tical rudder arrange-

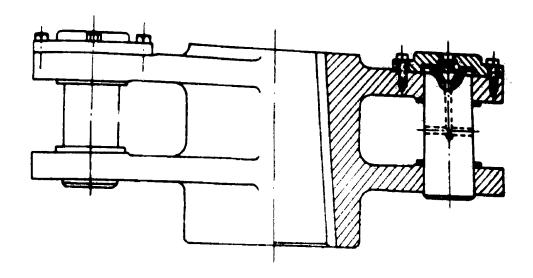
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	APPEND	ICES		
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FIG. 2. VERTICAL RUDDER
1-rudder blade; 2-rudder stock; 3-bearing; 4-bearing; 5-hub; 6-cup nut;
7-skeg; 8-step bearing; 9-lock washer

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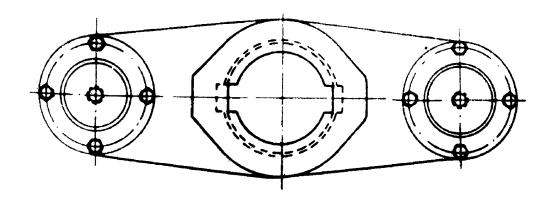
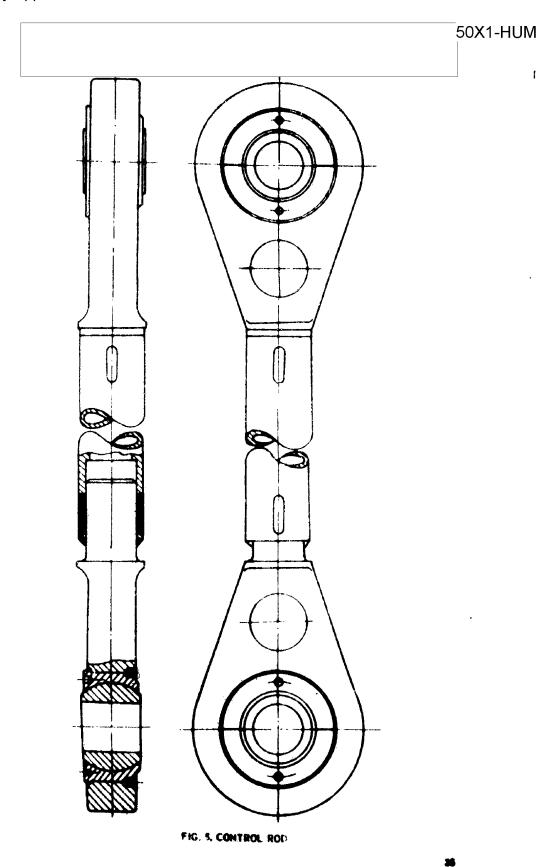


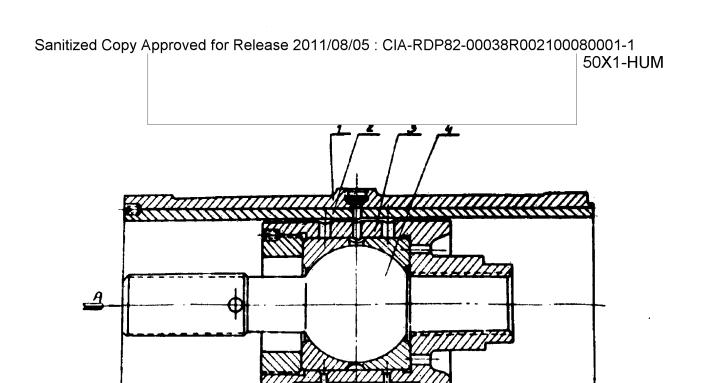
FIG. 3. TILLER



FIG. 4. DOUBLE-ARM LEVER 1-body; 2-lever pin

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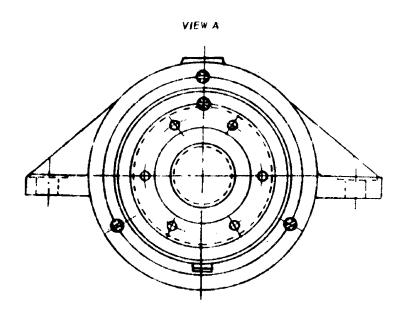


FIG. 6. GUIDE
1-guide body, 2-bush, 3-slipper (slide block); 4-ball head

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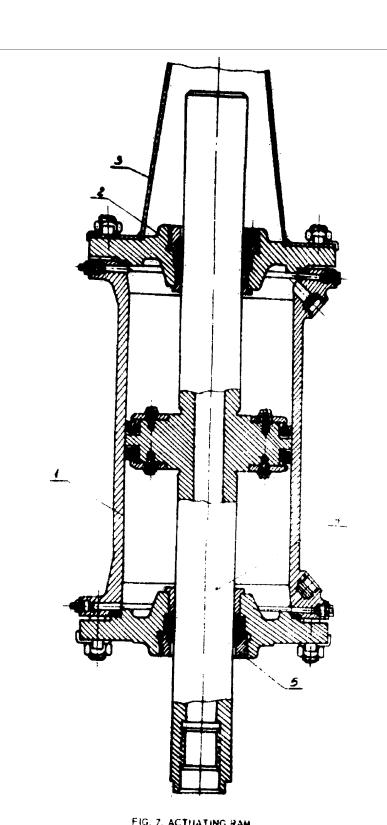


FIG. 7. ACTUATING RAM
1-cylinder; 2-cover; 3-cosing; 4-red with piston; 5-rack

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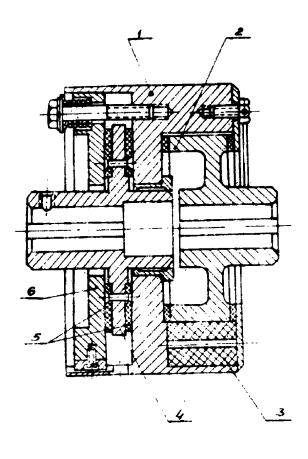
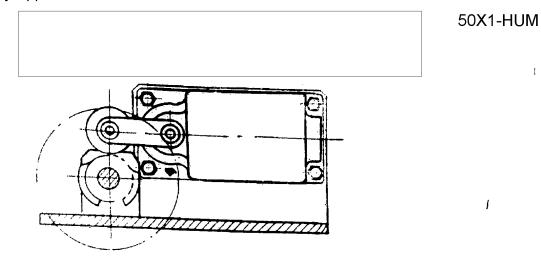


FIG. 8. FRICTION CLUTCH

!=body; '2=half-coupling; 3=pin, 4=half-coupling; 5=frict or

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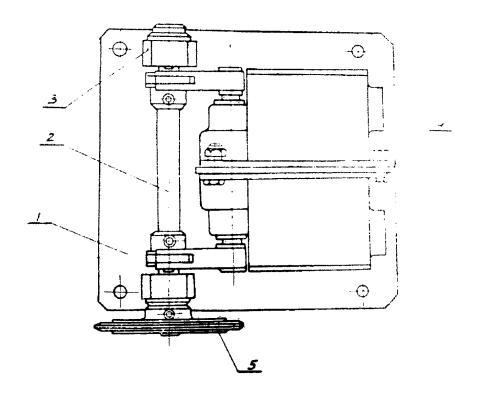


FIG. 9. BRACKET WITH LIMIT SWITCHES
1-bracket; 2-shaft; 3-cam; 4-limit switch; 5-sprocket



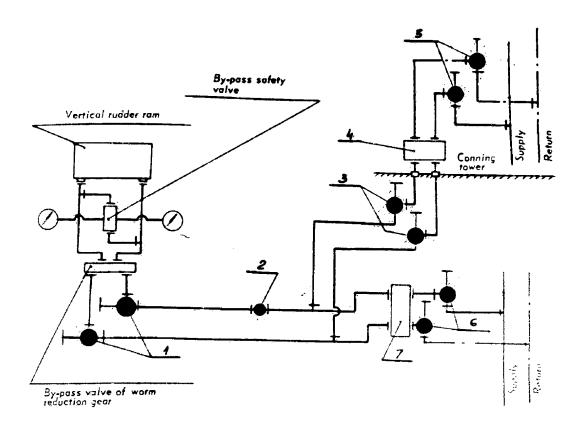
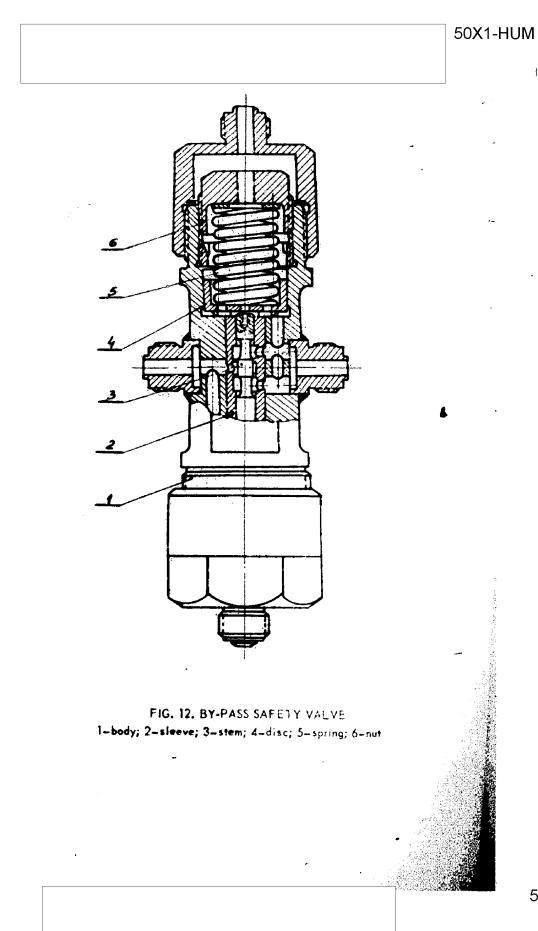
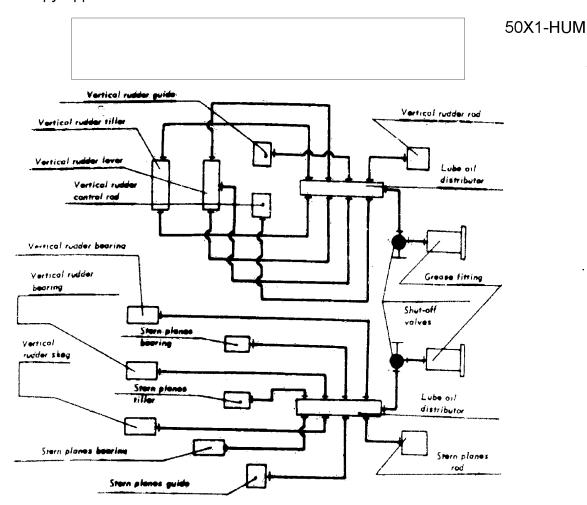


FIG. 11. ACTUATING RAM PIPE LINE
1-shut-off valves; 2-pressure-reducing valve; 3-shut-off valves; 4-control valve; 5-shut-off valves; 6-shut-off valves; 7-control valve





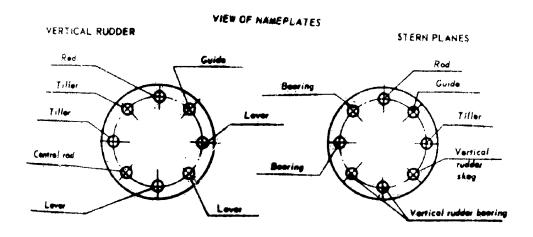


FIG. 13, VERTICAL RUDDER AND STERN PLANES DRIVES . LUBRICATION SYSTEM SCHEMATIC DIAGRAM

43

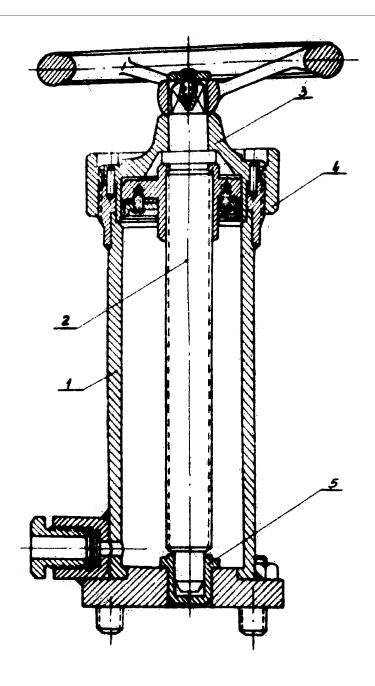


FIG. 14. PRESSURE LUBRICATOR
1-body; 2-screw with piston; 3-cover; 4-nut; 5-bush

44

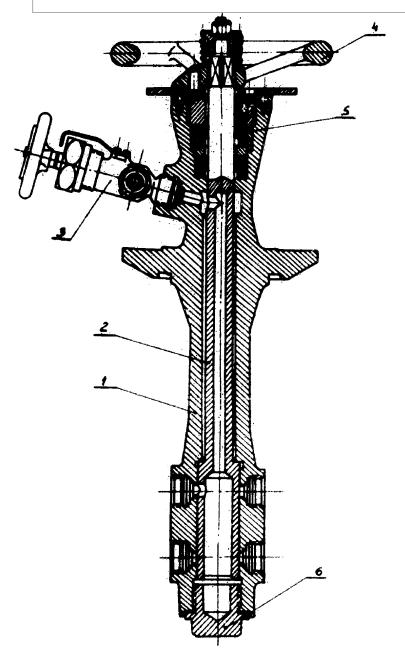
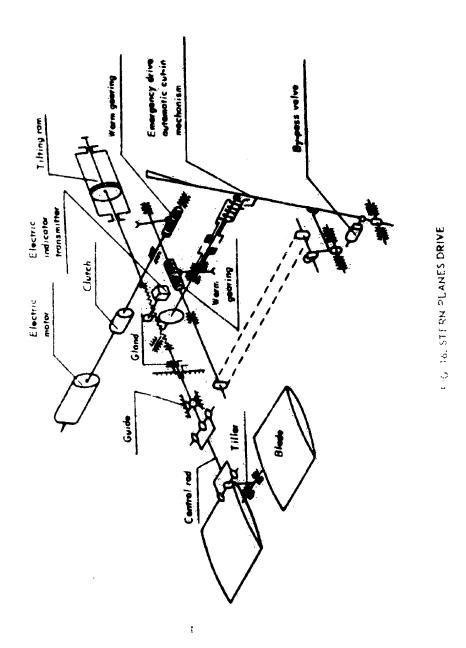
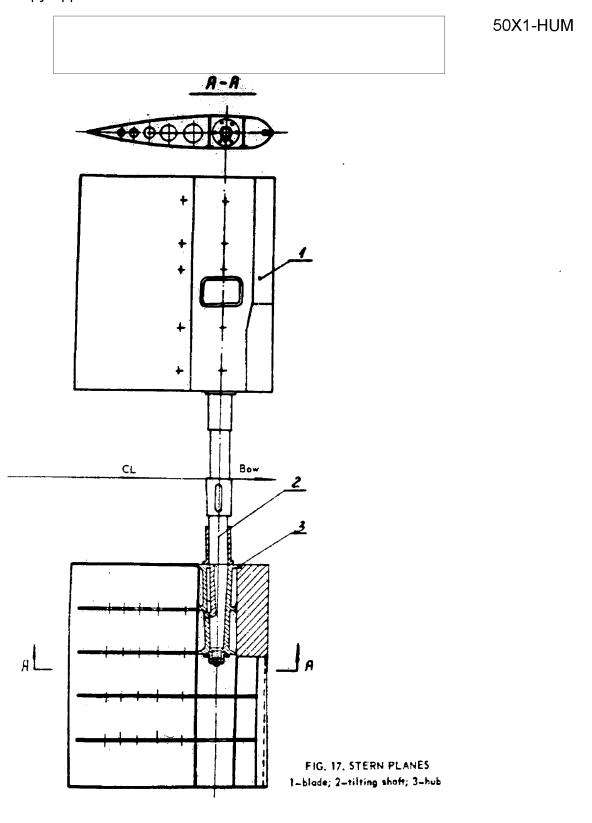


FIG. 15. LUBE OIL DISTRIBUTOR 1-body; 2-slide valve; 3-shut-off valve; 4-handwheel; 5-packing caller, 6-plug-nut

45





47

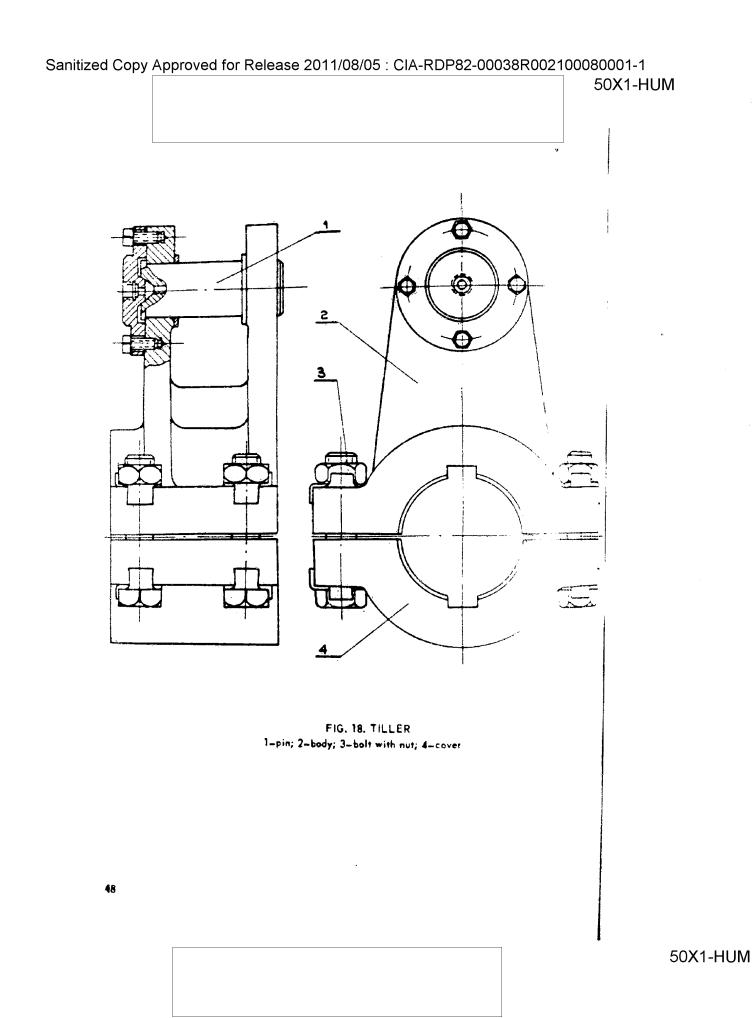
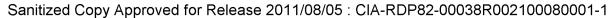


FIG. 19, CONTROL ROD





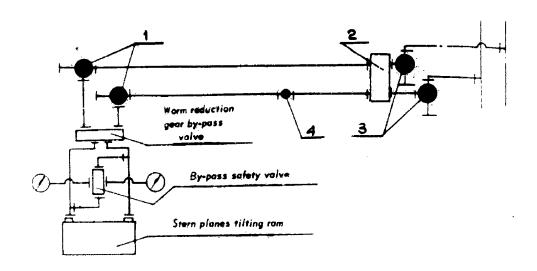
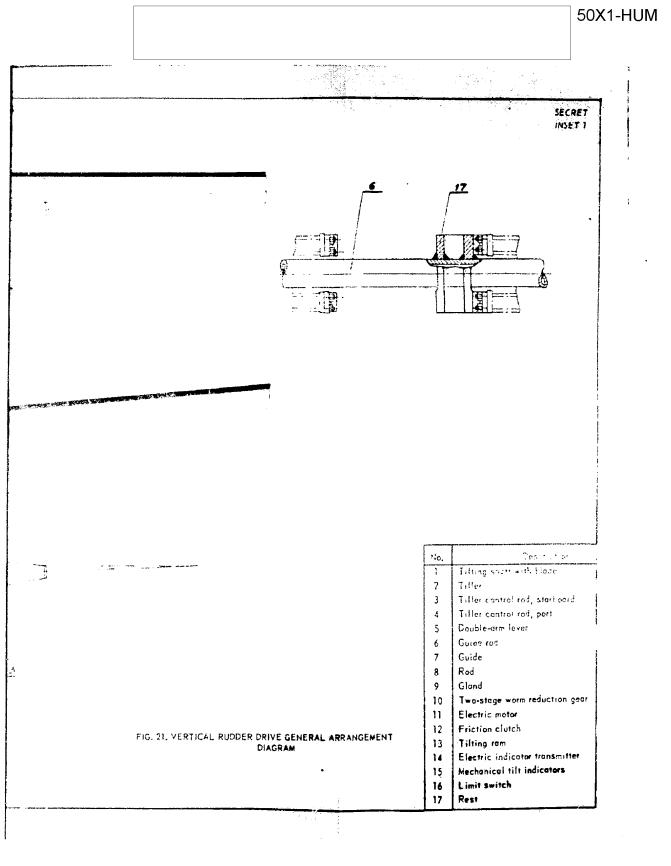
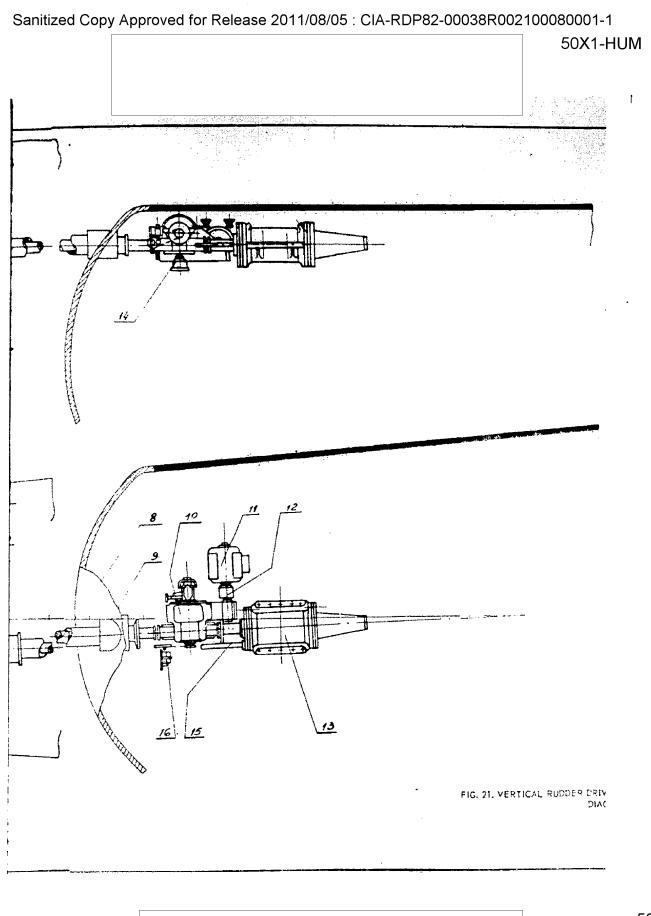


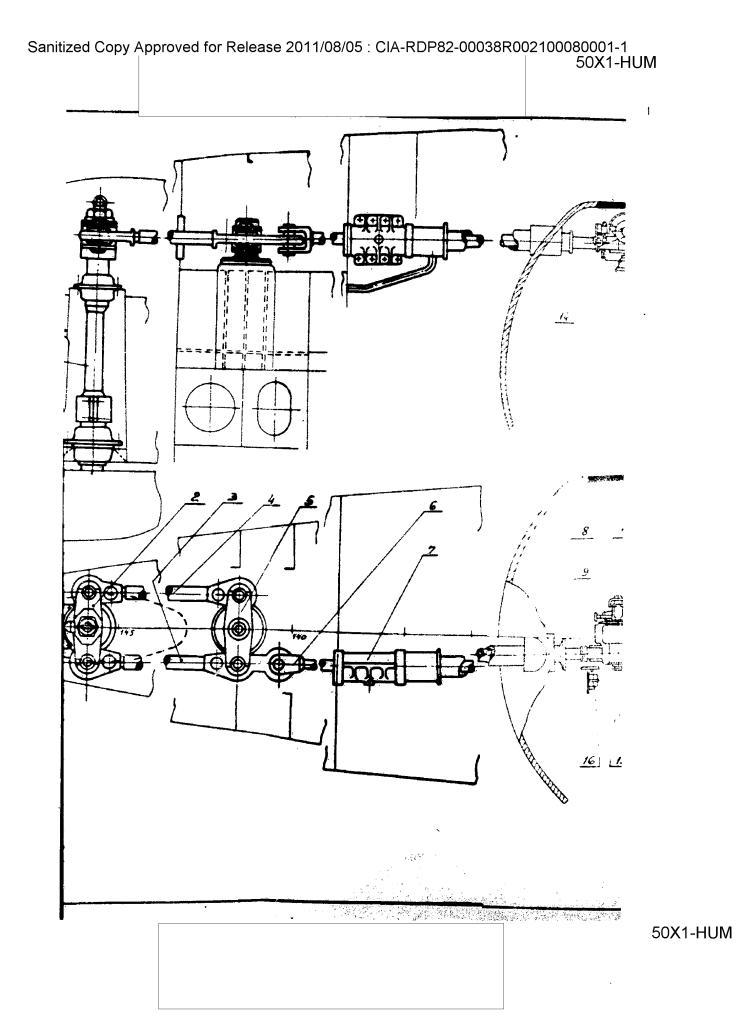
FIG. 20. TILTING RAM PIPE LINE
1-shut-off valves; 2-central valve; 3-shut-off valves; 4-pressure-reducing

50

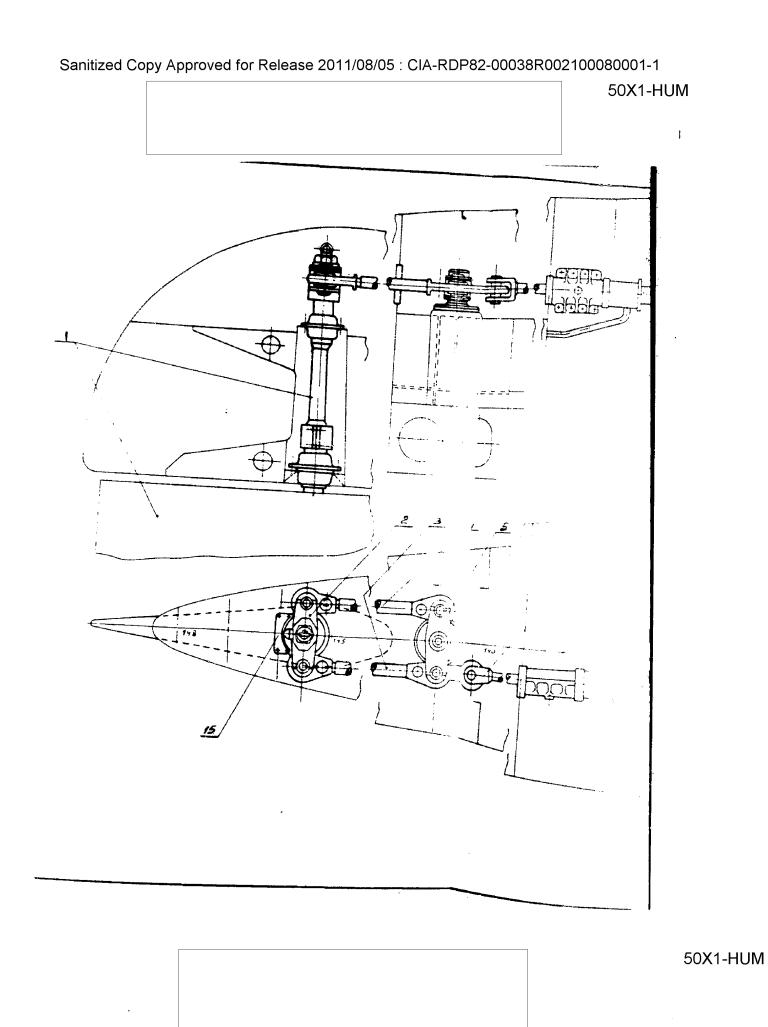




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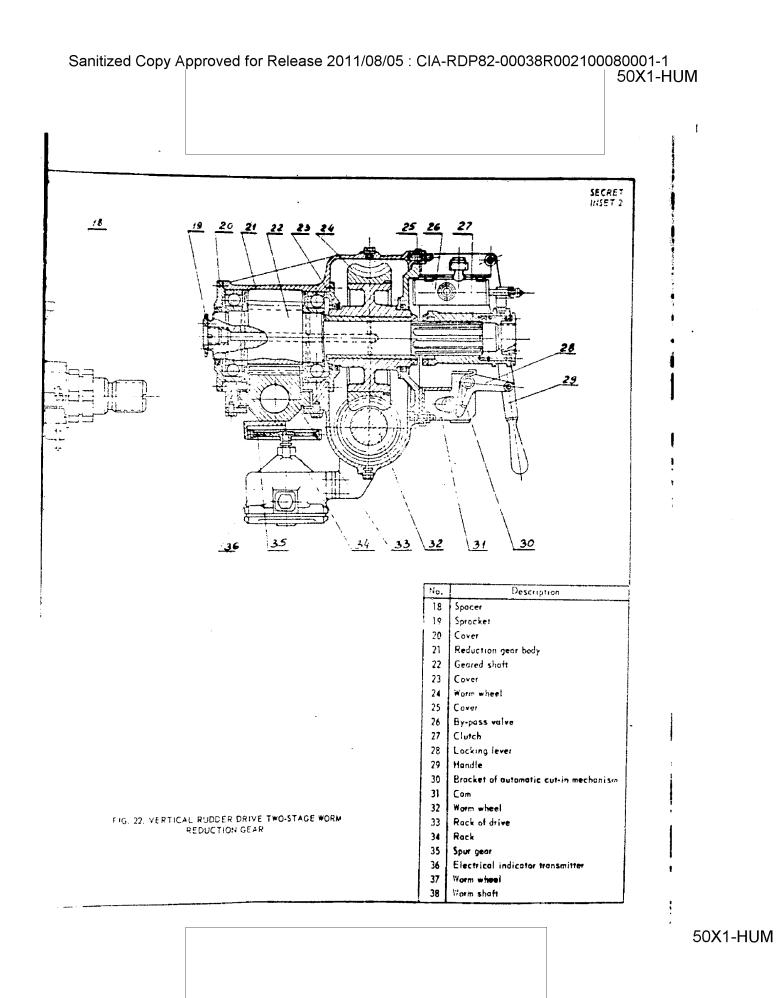
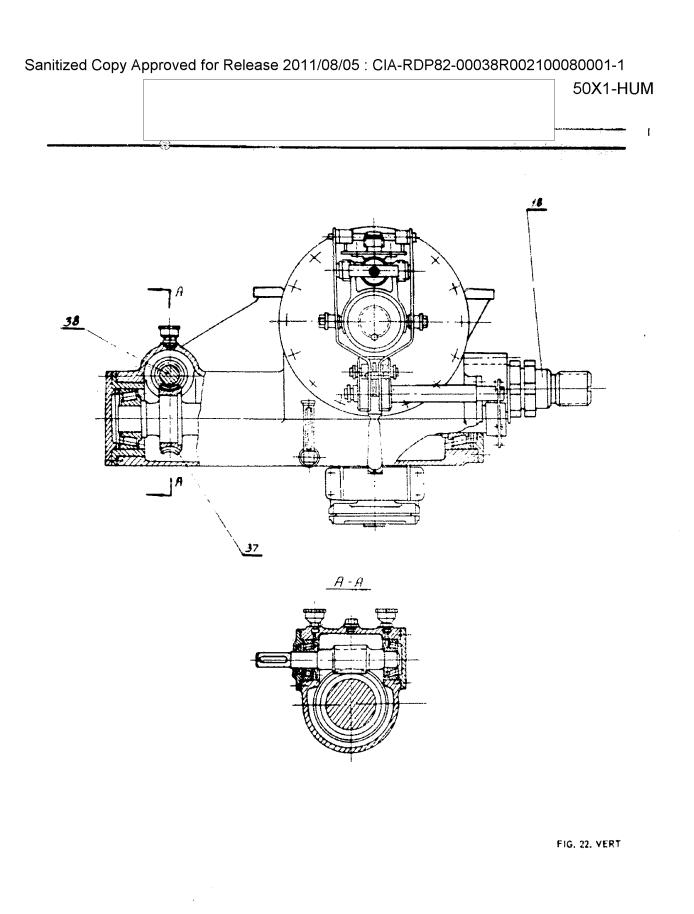
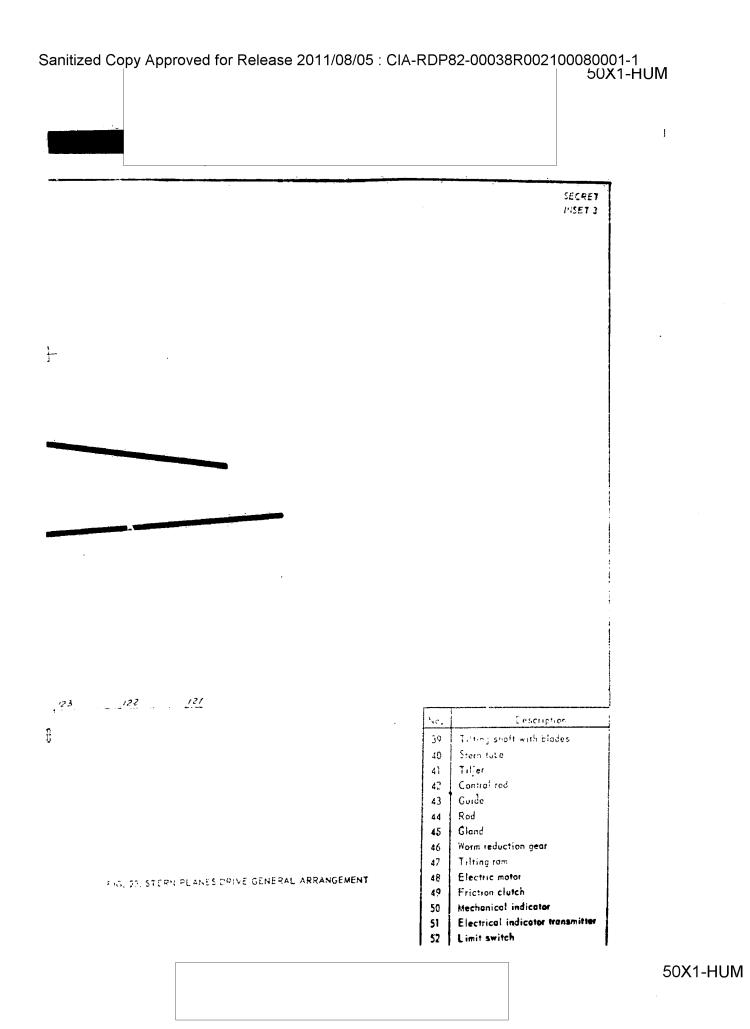
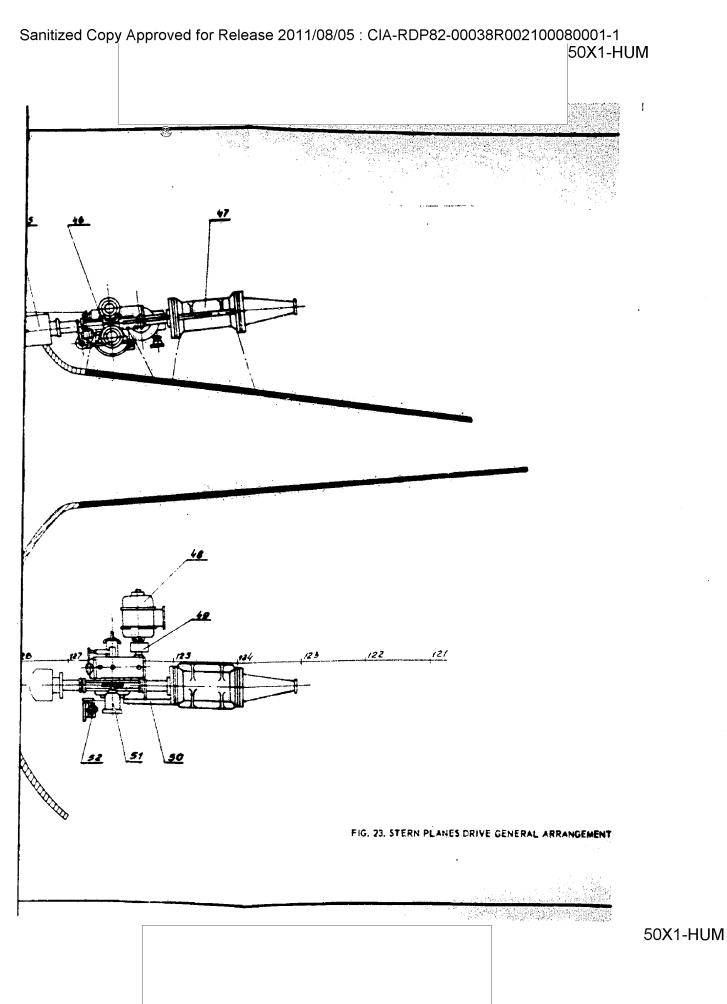


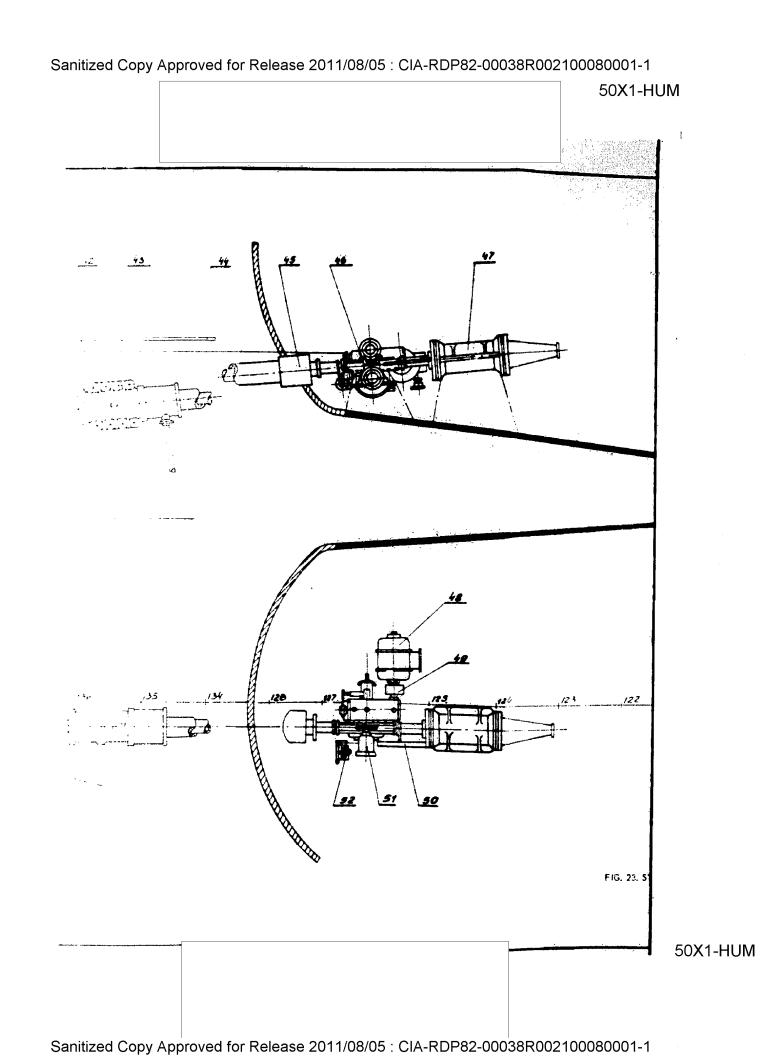
FIG. 22, VERTICAL RUDDER DRIVE TWO-STAGE WORM REDUCTION GEAR

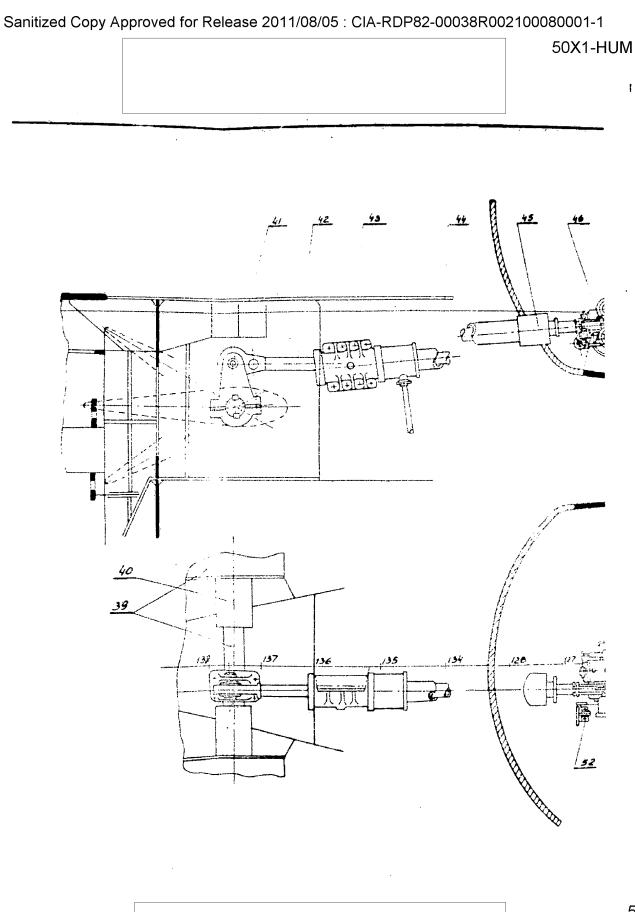






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FIG. 24. TWO-STAGE WORM REDUCTION GEAR OF STERN PLANES DRIVE	
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